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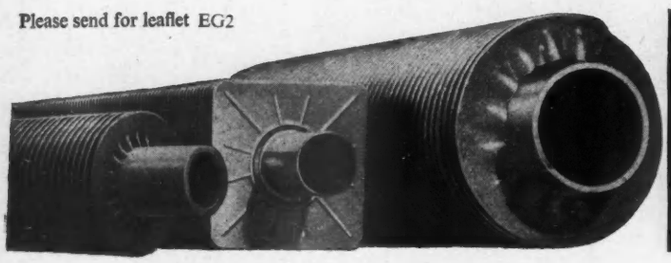

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ENGINEERING Impact

of Swiftly Growing European Transport

THE EUROPEAN Conference of Ministers of Transport show, in their recently released report on 1960, a major advance in the carriage of goods by rail, a slight slowing down in the rate of decline in passenger transport by rail and a lively increase in the tonnage carried on the inland waterways. The same onward rush continues in the number of road vehicles, their fuel consumption and most of all in international road transport.

The implications for manufacturing industry are not difficult to draw. The demand for high performance commercial vehicles looks like going on being very strong indeed, so long as the forward momentum in the European economy remains. On the railways the emphasis appears to be, as so many have for long predicted, towards the things the rail services can do best, the handling of heavy and long distance freight, the movement of passengers at speed and over distances that are beyond reasonable convenience by private car and not long enough for the aircraft to become a serious competitor.

There is something of the excitement of a campaign in the speed of growth in the countries of the European Economic Community. Such has been the call on all resources, of transport no less than of manpower, that the inland waterways have seen record increases in their utilisation. When the relatively small amount of goods moved by sea between European states is counted in with that on the inland waterways, this class of transport was found, between 1957 and 1958, to have declined in tonnage by 3 per cent. The following year (1959) brought a 4 per cent improvement, but in 1960 the rise became a rush and total tonnages went up by 18 per cent.

The improvement in cargoes on the Rhine and the Danube was even more impressive. From 1956 to 1959 traffic on the Rhine had moved between 104·5 million and 109·7 million tons each year. The continuing boom of 1960 took the total up to 130 million tons. This figure is something of an exception. It was influenced by the building early in the year of new transport capacity postponed in the low water spell late in 1959, and by the prolonged period of conditions favourable to navigation.

On the Danube similarly vigorous improvements took place. They were also affected by the long period in which river users were aided by the prevailing conditions. On the Austrian stretch of the Danube traffic increased by 25 per cent over the previous year. Along the Yugoslav reaches the improvement was 27 per cent.

Pipeline developments made important advances during the year. Twelve million tons of crude oil were carried into Western Germany by two pipelines linking the Ruhr and Cologne districts with Wilhelmshaven and Rotterdam. Both had begun service in July, 1960. Crude oil pipelines have been begun between Marseilles and Strasbourg (with a possible extension to Karlsruhe) and from Genoa to Aigle, in the Valais canton of Switzerland.

Two years ago European transport of goods by rail was only tentatively on the way back to the heights of 1957. Last year the total was clearly above that of three years earlier. The figures for the rail movement of goods, measured in ton-kilometres, in the OEEC countries and Yugoslavia are these (1953 = 100):

1954	..	103
1955	..	112
1956	..	117
1957	..	119
1958	..	111
1959	..	112·5
1960	..	121 (provisional)

For the member countries of the European Free Trade Association and the European Common Market the colume of expansion in railborne goods traffic was about the same and averaged about 10 per cent.

In rail passenger transport, where the decline has been about one per cent in 1958 and 1959, there was an average fall for 1960 of 0·7 per cent in the number of passengers and an increase of 0·5 per cent in the number of passenger miles. The European Transport Ministers, from their headquarters at the Chateau de la Muette, in Paris, conclude that rail passenger transport appears to have become stabilised while the increased trading activity has stimulated transport by private car.

Throughout the 16 OEEC countries and Yugoslavia in recent years there has been an average increase in the number of motor vehicles of 10 per cent a year. This was continued last year.

In most member countries road transport increased sharply, in some cases by over 15 per cent. International road transport expanded even more swiftly, increases of between 15 and 30 per cent and more were reported.

No Room for Road Complacency

THE figure of £43·5 million to be spent during the year on road maintenance in England, Wales and Scotland has been welcomed by Lord Derwent, the British Road Federation chairman—but with the cool look it deserves. In 1959, it is worth remembering, the Government's maintenance grants were £35 million and local authorities estimated that at least another 12·5 per cent would have to be added to that total to reach the necessary road standards.

Since 1959 there are more roads, not enough but at least some more, and the number of vehicles wearing out the roads has sharply increased. Road maintenance affects the safety of all users, it affects the efficiency of the road transport services, and it affects costs.

Lord Derwent has returned to the familiar, but still distressing, subject of the Government's great exactions in road taxation, some £645 million in the year now coming to an end—or, for easy reckoning, about four times the amount being spent on the road system.

That the Treasury and the Ministry of Transport are also studying the possibility of imposing tolls on future motorways leaves the BRF chairman speechless at the idea. If future motorways are designed with facilities for toll collection built in, it is certain that there will be no speechlessness then from the Federation and all the industrial users of road transport to whom the double penalisation, of an inadequate road system and of being compelled to pay more for using it, would be an affront.

of International Appraisal of Britain's City Crisis

WHETHER Britain's towns and cities can survive, or are surviving, under the impact of the popular car, of spreading populations and of the tenaciously clung to semi-detached habit, is a question often enough asked.

At Newcastle upon Tyne next week an internationally supported symposium is being held under the title Urban Survival and Traffic. It is organised by the University of Durham.

It seems a strong possibility that useful light will be thrown on the traffic and town planning problems of the United Kingdom by the five-day meeting. Its contributors have come from South Africa, Spain, Australia, West Germany and the United States.

One aim of the symposium has been described by its co-sponsors, the Roads Campaign Council, as the reconciling of the often different interests of architects, engineers and town planners in order to provide a basis for a combined assault on the traffic and associated problems threatening the future of most British cities.

It is in fostering this combined approach that the Council's symposium may do some of its most valuable work. A good deal of practical cooperation already takes place. And it is possible for all three links in the chain to be wrong at the same time, but if anything is certain in the confused and contentious business of how and in what way our cities should be formed for the future if is that if those concerned pull in independent directions, then either nothing at all will happen, apart from muddle, or when the forces do resolve themselves it will very probably be in quite the wrong way.

International Insurance for Primary Producers

WIDE fluctuations in the export earnings of the underdeveloped countries, who have mostly to rely upon providing primary products, are perhaps the most important single factor holding them back from steady economic advancement. A United Nations report, from a group of six set up by the Secretary General, Dag Hammarskjöld, recommends the creation of an international Development Insurance Fund. Financed by the contributions of the nations taking part in the scheme, the Fund would compensate countries suffering from a severe decline in export earnings, either by cash grants or by loans.

The advantages of such a scheme would be at least twofold. The government of a country whose income is principally dependent upon one or two raw materials would be able to plan for more advanced industrial development with much less doubt as to whether income would stay high enough to see the establishment phase through. It would also mean that with manufacturing other than the extraction of primary products moving forward more swiftly an increase in the volume of world trade could be expected to follow.

This, in time, might come to mean that the export possibilities from the old established industrial economies lay much more with capital goods and services than with manufactured consumer goods.

Governments being no more than human, a Development Insurance Fund would have to guard against efforts to get a bigger slice of the benefits by the manipulation of exports. For this reason the UN report suggests that coverage should be of only part of a serious decline in exports. Falls of only a few per cent would be best not covered at all since, to do so, might be to deter a producer from facing up to the implications of a permanent change in world demand.

Calculations made by the Secretary General's group led to the estimate that under one provisional scheme the potential industrial and high income primary producing countries would, in the years 1953 to 1959, have made claims averaging between £4·3 million and £50 million but would, taken together, have made a net contrubution to the Fund. For low income primary producing states the benefits would have covered 40 per cent of the shortfall in the years of greatest loss—1953, 1954 and 1958.

Tin Consumption Outstripping Production

WHETHER in bearings or in a multitude of other applications tin is in no serious danger of being relegated from the first division of industrial materials. But the current *Statistical Bulletin* of the Tin Council shows that for three years tin consumption in the world, excluding the Soviet Union, has been substantially ahead of production, and that even the peak production years of 1955 and 1956 fell behind the amount of tin used last year.

There is a buffer pool of stocks which comes into operation when the price of tin passes a certain level, but this does not change the basic position of a key material being used up faster than it can be produced.

Tin is also highly sensitive to the standards of personal consumption of the population. Accordingly only a small rise in the standard of living in great areas of the world could sharply accelerate the demand for tin.

The Tin Council's figures show that in 1960 world consumption, leaving out the USSR but including estimates for China and the Eastern European states, was 185,100 long tons, a postwar record. Production from the mines last year of tin-in-concentrates reached 158,900 tons, and this in a year when all restrictions had been lifted from the beginning of October. The production from the smelters last year was 171,000 tons.

An authoritative estimate that the gap between consumption and production this year will be in the order of 10,000 tons is felt to be conservative. Improvements in the output may be looked for when the Congo is working under normal conditions again but even then there is no immediate reason to suppose that the records of five and six years ago will be broken.

The position is one that a swift ending of the United States recession and other causes could make rapidly worse.

Strengthened Pvc Chemical Containers

So-called Tufplas structures are pvc bonded to glass reinforced polyester. They are proving valuable in chemical plant.

FOR chemical pipework and storage tanks, it is worth considering the use of an all-plastic structure. Pvc is one of the least expensive plastics and in resistance to chemicals it is particularly versatile.

Unfortunately, the temperature limitation of 60° C at which unreinforced pvc softens, and its low rigidity, make it desirable to exercise caution in specification of pvc for large vessels, where any sort of pressure is involved, or where structural integrity must be retained with a rise in temperature. It is thus interesting to note that when a pvc structure is covered with glass reinforced polyester, its temperature limit can be raised to 120° C for some applications, while its strength and rigidity are also vastly improved.

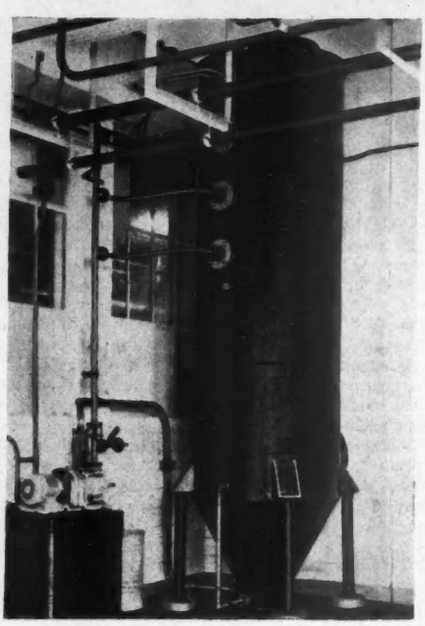
In the UK, one firm of resin makers sells a polyester which they claim will bond to pvc for such use, and another offers a different system in the form of a fabrication service. This second firm is Tough Plastics who were formed in 1957 as Cawley Plastics. The aim of this article is to show by example what had lead to the good reputation of their so-called Tufplas material.

A Tufplas structure is made by fabricating rigid pvc and covering this with glass reinforced polyester using a process which gives very high adhesion between the two layers. This adhesion is most important to satisfactory performance, for, should the bond break, the pvc is likely to ruckle up and break on the inside.

Repeated shear tests performed by one potential user of Tufplas (on samples with 0·15 sq. in overlap) gave shear strengths of 1,400 lb per sq. in—at least seven times that of any other pvc/polyester system they tested. This figure is just about 60 per cent of the long term tensile strength of the pvc itself, and is more than half the stress level of 2,000 lb per sq. in recommended for such structures on a safety factor of 10.

One most promising development is a 3,000 gallon tanker carried in the first instance in a cradle on a road lorry. This will be used for conveying sodium hypochlorite or hydrochloric acid, and the Home Office have agreed to observe tests for a period of six months.

Tough Plastics Limited, Weybridge, Surrey.



Acid Storage Tank

Illustrated above is a typical storage tank with a capacity of about 900 gallons. This one is installed at the works of T. Wall and Sons. It holds acid for a Permutit water treatment plant and will withstand weathering and splashes of acid even on the outer surface. It is supported by two semi-circular concrete plinths. Dome ends were formed in unplasticised pvc and welds made away from points of sharp curvature before reinforcement. For added strength, such points of small radii were given twice the normal thickness of reinforcement. Note also an all-plastic reinforcing band around the middle. Tough Plastics say they have made many similar vessels.

Ducts for Acid Fumes

The main trunk of the ducting shown below at the Coventry works of Courtaulds is 3 ft 9 in diameter. The total duct system, together with ancillary equipment, was delivered to site within four weeks of the order being received by Tough Plastics. Supports for this lightweight ducting are of simple construction and are therefore cheap. Tough Plastics say that rubber-lined steel, lead or stainless steel would normally have been chosen for this chemical. At flange joints there is a system of internal shields which prevent leakage of condensate present in the gases.

Process Tank

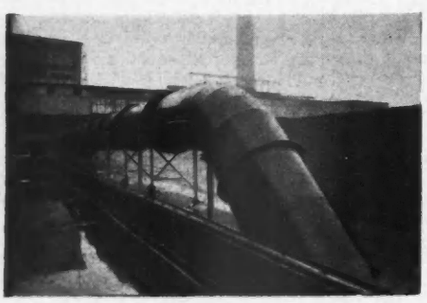
ICI General Chemicals Division needed a chemical tank which could support a cooling unit weighing about 5 tons. This demand was satisfied using a basic Tufplas construction with steel reinforcements bonded into the laminate to support the top flange. The final vessel—shown below—is 15 ft long, 6 ft 6 in wide, 3 ft 10 in deep, and weighs less than a ton. The cast iron cooling unit which will be bolted on top of the tank will do away with a need for lateral reinforcement. Note the elimination of four-point welds in the pvc lining by insertion of disc sections.

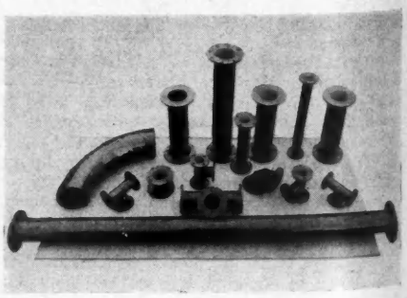
Scrubbing Tower

Tough Plastics believe that both stainless steel and rubber-lined steel had failed in an application for which Elektrochemische Werke eventually specified Tufplas. As shown on the left, this is now installed in a sodium chlorite plant in Germany. It was designed as a joint venture between the German and British firms, to meet what Tough Plastics describe as a particularly arduous chemical condition at temperatures up to 100° C. The makers say it is now working satisfactorily and claim that the customer is convinced that it will give a long and successful working life.

Pipes for Drainage and Effluent

A few of the many pipe fittings made in Tufplas are shown below. The material, say Tough Plastics, is competitive with copper even at reasonably high pressures and large diameters. For example, in a recent project in the North of England, 25,000 ft of 8 in pipe were needed for pure water main. Made in copper, the delivery period proved to be 2½ years from the date of order; Tough Plastics have contracted to deliver the material to site within six months from the date of order at a price said by them to be lower than that of any competing satisfactory material.





Metal Fibre Seals

Apparently arising from their research work into fibre metallurgy, Armour Research Foundation (of Illinois Institute of Technology) have developed a new material for use in high-temperature high-pressure static seals.

The composites, developed for the US Air Force, are made by impregnating a porous body of fibre metal with a soft metal. Resiliency of the fibre metal skeleton combines with the softness and conformability of the impregnant to offer a seal material which ARF think could be used for almost any static high-temperature high-pressure purpose. In addition, the metals envisaged or used already resist corrosion by

many chemicals, exotic fuels and hydraulic fluids.

The fibre metal skeletons, usually of molybdenum or stainless steel, are made by felting metal fibres, compressing them and then sintering to form a bond between the fibres at each point of contact. ARF say that the skeletons can be made as dense as desired and can be machined to desired shape by temporarily impregnating them with salt.

Experiments have shown that a composite made of a molybdenum fibre skeleton impregnated with silver retained hot air pulsating pressures from 0 to 5,000 lb per sq. in at 650° C. In other evaluations, the same composite material was subjected to temperatures cycled from 21 to 538° C with the same pulsating gas pressures from 0 to 5,000 lb per sq. in applied at both temperature extremes. After three such temperature cycles, ARF say there was no trace of leakage and no loss of bolt torque was detected.

Tests performed by Republic Aviation are also reported to indicate excellent static sealing results with the molybdenum-silver composite. Hydraulic fluids were retained for a total of 93 hours and 336,984 impulse cycles at 538° C in the tests without signs of leakage. This included repeated assembly, disassembly and twelve thermal cycles.

Use of such composite materials for dynamic seal applications as distinct from static ones is in the experimental stage. Plastic materials are apparently being tried as impregnants for the fibre metal skeletons with good results noted in the preliminary stages.

Illinois Institute of Technology, 35 West 33rd Street, Chicago 16, Illinois, USA.

Petrol Pump Has Viton Seals

First-class solvent resistance and dimensional stability are two reasons for choice of Viton rubber in a new British made petrol dispensing pump, say Du Pont.

This 1400 series Meteor pump, designed and manufactured by Wayne Tank and Pump Company, uses a number of dynamic seals of Viton in the meter unit for moving parts. It is essential that O rings, for example, are unaffected by the fuel passing through the meter. There are two shaft seals of Viton, one on the main rotating pump shafts and one on the drive shaft of the recording meter; in both cases the rubber is bonded to a steel casing. A Viton disc is employed as a seating for the pumping unit check valve, which is in continual contact with fuel. Similarly there is a small O ring of the rubber in the relief valve of the same assembly.

Depending on the fuel, elastomeric materials previously used were subject to shrinking and leakage past sealing points or to swelling to a point where the pump could not operate. Comparative 48 hour immersion tests on various materials in aromatic fuels showed Viton to have less than 1 per cent volume swell, compared with a figure of at least 15 per cent for other materials tested. Other tests showed the rubber to have good dimensional recovery in and out of liquids.

Viton rubber was first announced by Du Pont in the USA in 1958. It offers resistance to oils, fuels and solvents at temperatures above 225° C, say Du Pont. This enables design applications impossible with other types of natural or synthetic rubber. Precision seals, O rings, fuel cells, diaphragms, hose and tubing are some of today's uses.

The new petrol pump also makes wide use of neoprene synthetic rubber. Neoprene's good weather, ozone and fuel resistance have ensured its choice for the outer covering of the petrol delivery hose, Du Pont add. Neoprene closed cell sponge is used as the gasketing material for the fluorescent lighting housing. The sponge answered the requirements of being soft and spongy yet with closed cells so that it would be petrol vapour and waterproof. Neoprene gaskets are also used around the sight glass of the visigauge (or sight meter) which shows the customer that the petrol is flowing, and for securing the dial glasses.

Du Pont Company (UK) Limited, 76 Jermyn Street, London, SW1.

Wayne Tank and Pump Company Limited, Western Road, Bracknell, Berkshire.

Reinforced Polyester Instrument Housing

To avoid expensive tooling costs when developing a new atomic safety instrument, EMI Electronics of Hayes decided to have the housing made from

polyester resin reinforced with glass fibre. British Resin Products, suppliers of the polyester, say that when final modifications had been made, the engineers were so satisfied with the material that they decided to use it for production models.

The instrument is the new EMI single hand monitor, shown for the first time at the Physical Society exhibition. It provides a means of checking contamination on the hands of laboratory staff working with radioactive materials such as isotopes.

BRP say their Cellobond polyester resin reinforced with glass fibre was chosen because of the low cost of moulding strong units. The housings, incorporating a panel which can be removed for inspection and adjustment, are moulded by John Colinsons of Slough.

British Resin Products Limited, Devonshire House, Piccadilly, London, W1.

Mahogany for America's Cup Yacht

A log, 33 ft long and containing 253·4 cu. ft of timber, has been selected from a parcel of Honduras mahogany logs imported by W. W. Howard Brothers and Company. This will be used for the Red Duster syndicate's contender

for the America's Cup.

The illustration shows the log being band-sawn into boards at the Commercial Wharf, Poplar. They will now be stored for seasoning until wanted for construction of the yacht.

W. W. Howard Bros. and Company Limited, 4 Stanhope Street, London, NW1.

Lightweight Ventilation Ducting

Dorman Long (Steel) have installed a trial quantity of pvc-coated Terylene ventilation ducting made by Robert Watson at their ironstone mine

at North Skelton, Yorkshire. ICI, makers of the polyester fibre, say the users have found that Terylene ducting is considerably lighter in weight than the jute or canvas now being used, and is therefore easier to handle. It is also very much lighter and cleaner than metal ducting.

Robert Watson and Company, Newburgh, Fife.

Plain Words

By Capricorn

DILIGENCE is a virtue that is becoming very rare, I heard a publisher complain some weeks ago. Although to some extent I share his view, I have noticed also that we tend to do too many things too well. Can these two faults be reconciled? Can we be guilty, simultaneously, of indolence and over-zealousness? I have reason to believe we can. The two go well together.

A week or so ago I had the pleasure to be present at the Institute of Metals annual dinner. Mr. W. F. Cartwright, President of the Iron and Steel Institute, was the main speaker. After a little amiable intermetallic bickering, usual on these occasions, Mr. Cartwright turned to a subject acceptable both to ferrous and non-ferrous partisans—tinplate.

He said that a Mark IX Jaguar had been mounted on four Lyles Golden Syrup tins. After several senior executives had inspected this phenomenon, it was pointed out that treacle tins were not normally required to support the weight of motor cars, and it was therefore unreasonable to make them capable of performing so onerous a duty. Something was clearly wrong: the tins were far too good.

From this experiment emerged a new material—" skinny tinplate ".

But steelmen aren't alone in making better products than are necessary. I have seen engineering drawings as elegant as Rafael cartoons, twice as elaborate and taking many times the effort to prepare; when carefully dimensioned sketches would have been sufficient.

How can we be so tireless to so little purpose? Perhaps our diligence in action is a form of mental laziness. We would rather do a job than think about it first. How often I have spent several hours on a task and only realised afterwards that had I given it a moment's thought, I should have done it in less than half the time—or need never have tackled it at all.

Thinking is the method study of ordinary life, but in the complex world of industry even thinking becomes an elaborate technique, involving mathematics, operational research, even computers. We cannot afford to disregard the optimum, but should not confuse the optimum with perfection. Perfection, being an absolute, an end point on the scale of quality, is a relatively easy ideal. The right degree of imperfection is much more difficult to find.

But seeking optimums can itself consume a lot of time. What is the optimum effort to be spent in optimising?

In writing we can tolerate many imperfections in style or grammar before the sense is lost, much as a windscreen may be heavily splashed with mud before driving becomes dangerous. But if I fall short of perfection in this column, it is by accident rather than design. Perhaps I should be less fastidious—start leaving out the more familiar verbs, like the Russians do. That way in time I could work myself out of a job.

Letters to the Editor

Designer and Writer

SIR, Mr. Hugh Clausen contributes an interesting letter on the teaching of engineering design at universities in the issue of ENGINEERING dated 17 March, 1961, and this, taken in conjunction with the comment on engineering studies in London schools in " Engineering Impact " (p. 373 of the same issue) prompts me to the suggestion that some grounding in the art of technical writing and illustrating would be of some considerable benefit to any design engineer and, more particularly, to those other engineers and craftsmen who will have to interpret his work and bring it to practical use.

Every engineer doing original work must sooner or later prepare either or both of a report on his design and some instructions regarding its construction and how it works. There may also be factors regarding maintenance which must not be overlooked.

As a practising technical writer and illustrator I have found that although an otherwise brilliant engineer can produce the design for a new and complicated piece of machinery, when the unfortunate chap to whose lot it falls to prepare the technical publications gets to work on the sketches and written instructions prepared by the engineer (when they in fact exist), it is too often found that there are so many ambiguities, home-made symbols and abbreviations, and irrelevancies—to say nothing of some of the most peculiar " orders of going "—that quite a number of hours may be spent in mental sorting out and the settlement of queries which ought never to have arisen.

I may add that this feeling—sometimes almost of frustration—is shared by many of my fellow members of the Technical Publications Association, to the extent that one of the aims of the Association is to foster better education in the art of clear and orderly expression in the engineering world, both in written word and illustration. This, in conjunction with the City and Guilds Institute, at long last seems to be making some small headway; however, I cannot help suggesting that the inclusion of some elementary technical writing in the LCC courses might in time save quite a number of headaches for those of us who have to interpret the design engineers' work and pass it on to the user.

Yours faithfully,
P. C. TAYLOR, A.M.T.P.A.

Bilton, Rugby.
30 March, 1961.

Paternoster Lifts

SIR, The article entitled " Paternoster Lifts are Simple and Safe " (ENGNG., 3 Apr. '61, p. 338) makes a claim for the capacity of Paternosters as compared with lifts, which is most misleading. You publish a graph which purports to show that " one Paternoster will handle as many passengers in the upward direction as at least two modern high-speed lifts. . . ."

The graph merely shows the number of people who are carried by the lifts and Paternoster in a given time, and we are left with the impression that the figures shown are representative of the relative traffic handling capacities of the lifts and Paternoster.

To anyone acquainted with these problems it is easy to show that the two lifts in question have a maximum capacity of nearly double the maximum capacity of the Paternoster. The graph shows that the Paternoster was being used only to about half its potential capacity and both lifts at very much less.

It is also rather absurd to designate lifts at 250 ft per min as high-speed lifts when there are many installations in this country at three times this speed and double the speed at 500 ft per min has been commonplace again in this country for over thirty years.

Yours faithfully,
S. H. ROTHWELL.

Newcastle upon Tyne, 3.
15 March, 1961.

Editor's Note: J. & E. Hall Ltd. comment on Mr. Rothwell's letter as follows:

(1) The graph was prepared shortly after the lifts were installed and the result shown was what happened to the traffic on this particular occasion, showing that the Paternoster lift was that which was most favoured and used. We make no further claims for this graph and this is the only graph that has been prepared.

(2) This was the first installation embodying passenger lifts and Paternoster lift for this particular organisation, and the performance of this first Paternoster lift has resulted in their deciding to install Paternoster lifts in their other office buildings in this country which they have erected since.

(3) As the *only lift firm* who have made and installed passenger carrying Paternoster lifts in this country, we do not agree that the two passenger lifts have nearly double the capacity of the Paternoster lift, when allowance is made for loading time, door operating time, acceleration, deceleration. It is in fact doubtful whether the two lifts have the same capacity as the single Paternoster.

Regarding the question of speed of the passenger lifts, 250 ft per min is still considered to be fairly high speed, and in most modern office buildings the speed is only increased to 300 or 350 ft per min where the travel is fairly long, say 8 to 10 floors. There are plenty of passenger lifts still installed today in office buildings up to at least six floors where the lifting speed is only 100 ft per min so it will be seen that 250 ft per min is 2½ times faster.

We are well aware of the fact that on the higher travel lifts serving say 10 to 15 floors, 500 ft per min or higher is perhaps warranted and we have installed a number of passenger lifts at 500 ft per min both in this country and abroad. However, where lifts are serving long travels necessitating 500 ft per min this would be hardly the location for a Paternoster lift.

Give Us the Tools

SIR, Archaeological societies in Essex, Hertfordshire, London and Middlesex are often called on to carry out detailed survey of excavations. Unfortunately, few of these societies have funds which exceed £100 a year and they cannot afford surveying instruments. Moreover, when they try to borrow instruments they are always " in use ". I wonder if there are among your readers' firms which have ancient or obsolete instruments in working order which they could present to our group for distribution among archaeological societies.

The kind of instruments would be theodolites, dumpy levels (very useful for digs), Sopwith staffs, surveying compasses, plane tables and chains.

Now that building and other developments are on a large scale, the work of archaeological societies functioning on a shoe-string needs as much encouragement as possible.

Yours faithfully,
FRANCIS CELORIA,
Thames Basin Archaeological Observers' Group.

The London Museum, London, W8.
29 March, 1961.

Noise Annoyance

SIR, I must thank Mr. Fouvy for his comments (ENGNG., 17 Mar. '61, p. 376) on my paper given to the British Association and for pointing out some corrections. The paper was prepared for a verbal presentation, there being no intention whatsoever of the figures being used other than for illustration.

Dealing with the specific points he mentions in the order of his letter:

1. The spectra of Fig. 2 and Fig. 3 were intended to be of the same kind rather than identical.
2. I agree that Mr. Fouvy's title might be better for Fig. 2.
3. " Miles " is stated clearly in the print.
4. (*a*) Fig. 4 has no scale, deliberately.

(*b*) The percentages should not add up to 100 per cent since, as mentioned in the lecture itself, some people gave more than one reason.

(*c*) Table I is correct.

5. This error was explained in my letter, ENGNG., 16 Sept. '60, p. 373.

Yours faithfully,

E. J. RICHARDS.

The University,
Southampton.
28 March, 1961.

German Mathematics Vocabulary

SIR, May I refer to the review of the book *Grundlagen der Analysis*, by Mr. D. B. Welbourn (ENGNG., 10 Mar. '61 p.364) in which he mentions that there is room for a dictionary of mathematical vocabulary.

In the issue of 11 March, 1961, of the *VDI Zeitschrift*, the German publishing company Wila-Verlag, Munich 12, advertised their new book *Mathematisches Vokabular* (Mathematical Vocabulary: English-German/German-English) by Dr. Ing. Berthold Klaften.

You may care to draw Mr. Welbourn's attention to this new publication.

Yours faithfully,

N. KUHN.

Metalastik Limited,
Leicester.
29 March, 1961.

Capricorn's Accusative

SIR, Perhaps Capricorn, in Plain Words in your issue of 31 March, daring to be corrected on his use of the colon, should review the uses of prepositions and conjunctions. Isn't "as" a conjunction to be followed by the nominative or subjective case? See paragraph three.

". . . Someone as ignorant as me?"

Yours respectfully,

N. H. Wade.

Barnes,
London, SW13.
April Fools' Day, 1961.

Editor's Note: When Capricorn nods he normally justifies himself by pleading use of the vernacular, but on this occasion he declares that he was only trying to be objective.

Events in Advance

Iron and Steel Institute to Visit the USA

ARRANGEMENTS are being made by the Iron and Steel Institute to hold a special meeting of the Institute in the United States and Canada during October and November next. This occasion will be only the third time that the Institute will have held a meeting in America; the two previous occasions having been in 1890 and 1904. Plans for holding a meeting in America in 1938 were abandoned owing to the Munich crisis.

There will be six sections to the coming meeting, arranged in chronological succession and covering the period from 17 October to 8 November, 1961. These sections will be held, respectively, at New York, Niagara Falls and Canada, Cleveland or Detroit (alternative programmes), Pittsburg, Washington, and, back again, at New York. In most cases, some trips to places of interest will be intermingled with visits to the countries' major iron and steel undertakings.

In addition, there will be two, alternative, post-meeting tours. One will cover a tour of Middletown and Chicago, where visits will be paid to the Armco Steel Corporation, the United States Steel Corporation and the Inland Steel Corporation. The other tour will be a purely tourist excursion, including visits to Colonial Williamsburg, Richmond, Va., and surrounding places of interest.

Provisional arrangements for the visit have already been worked out and are available upon request, but the final programme will not be ready for another two to three months.

Copies of these programmes and additional information may be obtained from the assistant secretary, the Iron and Steel Institute, 4 Grosvenor Gardens, London, SW1, or by telephoning SLOane 0061.

Meetings and Papers

British Institution of Radio Engineers

LONDON
"Computer Control of Air Traffic": Symposium. Joint Meeting of the Computer and Radar Groups. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 3 May, 5.30 p.m.*

CHELTENHAM
"The Mesa Transistor and Its High-Frequency Applications, by D. H. Mehrtens. South Midlands Section. North Gloucestershire Technical College, Cheltenham. Fri., 21 April, 7 p.m.

British Nuclear Energy Conference
Institution of Chemical Engineers

LONDON
"Development of Fluid Fuel Reactors," by Dr. Alvin M. Weinberg. Federation of British Industries, 21 Tothill Street, SW1. Mon., 24 April, 5.30 p.m.* (Non-members may attend; tickets not being required.)

Chemical Society

CAMBRIDGE
"Stereochemistry of Some Dissolving Metal Reductions," by Dr. M. J. T. Robinson. Cambridge Branch. University Chemical Laboratory, Lensfield Road, Cambridge. Mon., 24 April, 5 p.m.

Institute of Marine Engineers

LONDON
Presidential Address, by Viscount Simon. Followed by the Annual General Meeting of the Institute. Tues., 25 April, 5.30 p.m.*

Institute of Petroleum

LONDON
"New Ideas in Welding for the Petroleum Industry," by W. K. B. Marshall and V. I. Holmes. Wed., 3 May, 5.30 p.m.*

Institute of Refrigeration

LONDON
"Metals for Refrigeration and Other Low Temperature Installations," by G. P. Smedley. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 4 May, 5.30 p.m.*

Institute of Road Transport Engineers

DURHAM
Annual General Meeting. North Eastern Centre. Three Tuns Hotel, Durham City. Tues., 25 April, 7 p.m.

GLASGOW
Annual General Meeting. Scottish Centre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Mon., 24 April, 7.30 p.m.

LIVERPOOL
Annual General Meeting. North Western Centre. Merton Hotel, Merton Road, Liverpool 20. Thurs., 27 April, 7.30 p.m.

Institution of Agricultural Engineers

LONDON
Annual General Meeting, at 10.30 a.m. Conference: "Tractor Requirements for International Agricultural Engineering Standards," by C. H. Hall, at 11.30 a.m.; Discussion on "Why Plough?" opened by J. Gass, G. P. Harding, and J. C. Hawkins, at 2.30 p.m.; and "Technological Considerations of the Uses of Metals in Agricultural Engineering," by Dr. I. G. Slater, at 4.15 p.m. Annual Dinner, at 7 for 7.30 p.m. Piccadilly Hotel, W1. Tues., 25 April.

Institution of Civil Engineers

LONDON
"New Tunnels Near Potters Bar in the Eastern Region of British Railways," by A. K. Terris and H. D. Morgan. Tues., 2 May, 5.30 p.m.*

Institution of Electrical Engineers

LONDON
"Progress Report on the Development of a Photo-Electric Beam Index Colour Television Tube and System," by R. Graham, J. W. H. Justice and J. K. Oxenham. Electronics and Communications Section. Mon., 1 May, 5.30 p.m.*
"Structural Properties and Applications of Evaporated Metal Films," by Dr. D. W. Pashley; and "Deposition of Evaporated Non-Magnetic Films," by J. R. Balmer. Joint meeting of the Measurement and Electronics Sections. Tues., 2 May, 5.30 p.m.*

BELFAST
Annual General Meeting. Northern Ireland Centre. Civil Engineering Department, David Keir Building, Queen's University, Stranmillis Road, Belfast 9. Tues., 2 May, 6.30 p.m.*

BIRMINGHAM
"Silicon Power Rectifiers," by A. J. Blundell, A. E. Garside, R. G. Hibberd and I. Williams. South Midland Centre. Jame Watt Memorial Institute, Great Charles Street, Birmingham Mon., 1 May, 6.30 p.m.

MIDDLESBROUGH
"An Analytical Approach to Industrial Lighting," by W. Imrie-Smith. Annual General Meeting. Tees-Side Subcentre. Cleveland Scientific and Technical Institute, Middlesbrough. Wed., 3 May, 6.30 p.m.*

NORWICH
"Generator/Motor Problems in Pumped-Storage Installations," by Dr. J. H. Walker. East Anglian Subcentre. Assembly House, Norwich. Mon., 1 May, 7.30 p.m.

Institution of Electronics

MANCHESTER
"Techniques for Digital Data Links," by F. G. Heath. Manchester Branch. Manchester College of Science and Technology, Sackville Street, Manchester 1. Fri., 28 April, 7 p.m.

Institution of Engineering Inspection

SOUTHSEA
Annual General Meeting. Southern Area Branch. Royal Beach Hotel, Southsea. Mon., 24 April, 7.30 p.m.

Institution of Heating and Ventilating Engineers

GLASGOW
Annual General Meeting. Scottish Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow, C2. Tues., 25 April, 7 p.m.

Institution of Mechanical Engineers

LONDON
Annual General Meeting. Wed., 26 April, 6 p.m.* (Open to corporate members only.)
"Acid Cleaning as Applied to Steam Power Plant": Discussion, to be opened by R. F. Fisher. Steam Plant Group. Thurs., 27 April, 6 p.m.*
"Lotus: Its Design and Development," by H. J. Lee. London Graduates' Section. Fri., 21 April, 6 p.m.*

PLYMOUTH
"Hovercraft," by G. J. Thomson. Western Branch. HMS Thunderer, Royal Naval Engineering College, Manadon, Plymouth. Fri., 28 April, 7 p.m.

Institution of Mining and Metallurgy

LONDON
"Experimental Study of Adsorption and Desorption of Xanthane by Sphalerite," by T. Yonezawa; and "Naphthenic Acid as a Liquid-Liquid Extraction Reagent for Metals," by A. W. Fletcher and J. C. Wilson. Geological Society, Burlington House, Piccadilly, W1. Thurs., 20 April, 5 p.m.*

Institution of Plant Engineers

BIRMINGHAM
"Fibreglass Reinforced Plastics," by G. O. Gurney. Birmingham Branch. Imperial Hotel, Temple Street, Birmingham. Fri., 28 April, 7.30 p.m.

CHESTER
"Problems Associated with the Running of a General Engineering Works," by C. J. Wright. Merseyside and North Wales Branch. The Blossoms, Chester. Thurs., 27 April, 7.15 p.m.

LEICESTER
"Mechanical Handling," by N. A. L. Thorne. Leicester Branch. Midland Hotel, Leicester. Wed., 26 April, 7.30 p.m.

MIDDLESBROUGH
"Lubrication of Internal-Combustion Engines for Minimum Wear," by H. Middleditch. North East Branch. Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough. Thurs., 27 April, 7 p.m.

Institution of Structural Engineers

LONDON
"Composite Construction in Theory and Practice," by Professor Dr. Ing. Konrad Sattler. Thurs., 27 April, 6 p.m.*

BIRMINGHAM
"Modern Urban Highway Structures," by G. B. Smedley. Midland Counties Branch. College of Advanced Technology, Gosta Green, Birmingham 6. Fri., 28 April, 6.30 p.m.

LEEDS
"Timber as a Structural Material," by I. H. Paxton. Yorkshire Branch. Metropole Hotel, King Street, Leeds. Wed., 26 April, 6.30 p.m.

Reinforced Concrete Association

BRISTOL
"The Code of Practice for Prestressed Concrete C.P.115," by A. W. Hill. West of England Branch. New School of Engineering, The University, Bristol. Thurs., 27 April, 6 p.m.*

Royal Aeronautical Society

LONDON
"On the Origin, Structure and Growth of Vortex Separations," by E. C. Maskell. Tues., 25 April, 7 p.m.

Royal Society of Arts

LONDON
"The Training of Scientists and Engineers for Industry," by Sir John Cockcroft. Trueman Wood Lecture. Wed., 26 April, 2.30 p.m.

Southampton Metallurgical Society

SOUTHAMPTON
"The Development of Cast Metals," by Dr. H. T. Angus. Southampton Technical College, Southampton. Wed., 26 April, 7.15 p.m.

The address and telephone number of headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk(*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
British Nuclear Energy Conference, Great George Street, London, SW1. (WHItehall 4577)
Chemical Society, Burlington House, Piccadilly, London, W1. (REGent 0675)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institute of Refrigeration, New Bridge Street House, New Bridge Street, London, EC4. (CENtral 4694)
Institute of Road Transport Engineers, 1 Cromwell Place, South Kensington, London, SW7. (KENsington 3744)
Institution of Agricultural Engineers, 6 Queen Square, London, WC1. (TERminus 0140)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. (BELgravia 3647)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Electronics, 78 Shaw Road, Thornham, Rochdale, Lancs. (Oldham Main 6661)
Institution of Engineering Inspection, 616 Grand Buildings, Trafalgar Square, London, WC2. (WHItehall 0818)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Mining and Metallurgy, 44 Portland Place, London, W1. (LANgham 3802)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Southampton Metallurgical Society. Apply to Mr. S. W. Hallwood, Folland Aircraft Limited, King's Avenue, Hamble, Hampshire.

Combined Operations for UK Air Safety

A completely integrated military and civil air traffic control system to reduce the risk of aircraft collision above 25,000 ft has been introduced in the United Kingdom.

THE amount of air space over the United Kingdom is insufficient to meet the demands of the many high-speed military and civil aircraft except on a coordinated basis.

Positive steps have now been taken by the Air Ministry, representing military aircraft, and the Ministry of Aviation, representing civil aircraft, in introducing a completely integrated air traffic control system for the UK. The long term aim is to provide safety from collision with the minimum of restrictions.

Until recently, the Air Traffic Control (ATC) system in the UK was largely based on a policy of segregating military aircraft from civil wherever possible by providing for the civil aircraft a system of air routes and other forms of controlled airspace.

Upper Air Routes

Nowadays, the majority of military aircraft are jets which operate above the Airways System and until comparatively recently they enjoyed exclusive use of the upper airspace. During 1958, civil jet airliners began coming into service operating at service ceilings of above 25,000 ft. As their numbers increased, the need was created for an ATC system for both civil and military aircraft in the airspace above 25,000 ft, the upper limit of the Airways System.

Naturally, military aircraft need greater flexibility in their movements than civil aircraft, which in the main follow a fixed route system linking the civil airports. The Airways System for civil traffic must therefore restrict the freedom of movement of military aircraft to a certain extent. To meet this difficulty, ground radar equipment provides an Airways Crossing Service for military aircraft and during the past two years some 50,000 military aircraft have been taken through the airways.

It was recognised that the differing operating requirements of military and civil aircraft in the Upper Airspace over the UK could not be met by a simple upward extension of the policy of segregation as had been the case in the Lower Airspace.

The first step in controlling the Upper Airspace was taken in 1959 when the Upper Airspace Interim Radar Scheme was initiated as a joint venture between the two Ministries. RAF and Civil ATC radar installations could be exploited to provide a service to aircraft above 25,000 ft. This decision was based on successful experience in the Lower Airspace.

Accordingly, the UK has been divided into three Upper Flight Information Regions through which runs a network of Upper Air Routes along which civil and military transport aircraft fly.

The first of these joint high level control and surveillance radar installations to come into use was recently visited by ENGINEERING. Situated on the Northern Ireland coast near Bishops Court, it provides a service extending for 180 miles radius. Contained in these boundaries are Northern Ireland, most of Scotland, Northern England, the Irish Sea and the North Atlantic approaches to the UK. Two further joint units have now been brought into operation and these provide cover over Central and Southern England, and the Western Approaches to the UK. These units are situated at Hack Green (near Nantwich, Cheshire) and Sopley (near Christchurch, Hants). Plans are in hand for other Radar Units to come into operation in the north east and south east to cover the remainder of the Upper Airspace over the UK.

Until recently, the Air Traffic Control system in the United Kingdom was largely based on a policy of segregating military aircraft from civil. As civil jet airliners came into service operating at service ceilings of above 25,000 ft—originally the sole province of military aircraft—the need for more positive control became necessary.

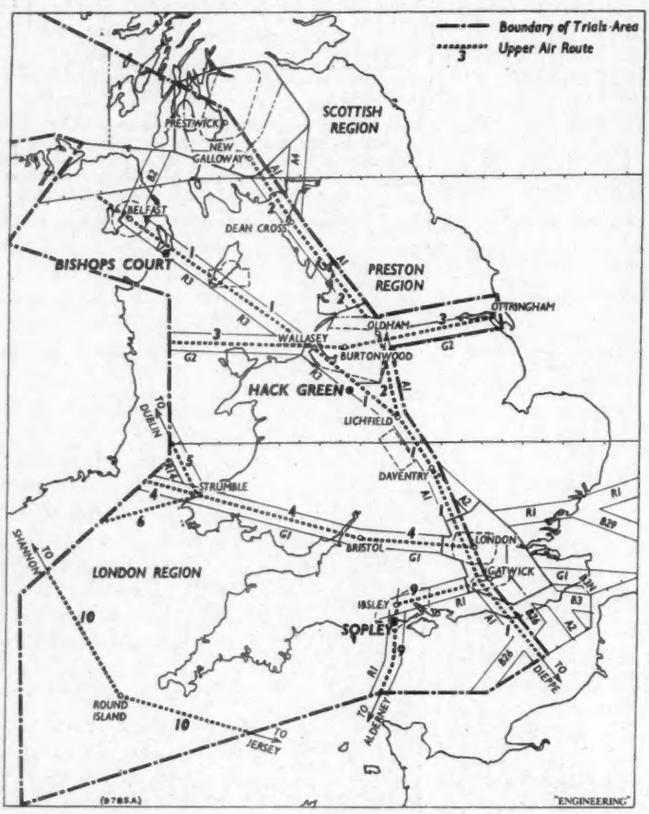
Future Developments

The RAF—who do and will continue to do 65 per cent of the flying over the UK—intend to extend the service to lower levels. Future new and more powerful radar units for air defence will also contribute directly to the radar cover over the UK for surveillance for ATC. Layout and equipment will be developed so that maximum aid is given to civil operations. The radar pictures from them will be relayed to the main joint ATC centres, where the radar pictures will also be relayed from other radar sources sited solely for ATC purposes.

The system will be automatic and it is planned to locate the data processing, data storage and computing facilities required to resolve air defence problems, so that they will be readily available to the new ATC centre in the London area and thus facilitate their use for ATC.

By making available to ATC the equipment being developed for air defence purposes by the RAF, it will be possible to advance the introduction of improved and more effective control facilities for military and civil air traffic, for several years.

Experience gained in operating the system as it stands at present will be used for developing it for use at lower levels. It will also assist in the planning of the international agency, Eurocontrol, who are at present looking at the problems of control in the Upper Airspace over six European countries, including Britain.



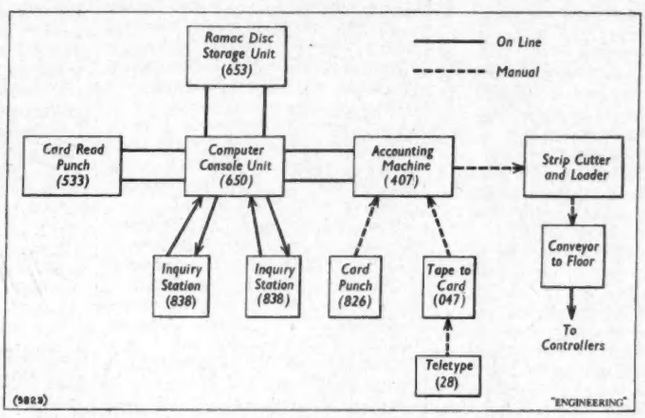
(*Left*) *Radar services operated by the Air Ministry and the Ministry of Aviation will provide safe separation between all aircraft in the Upper Airspace over the UK. For this purpose the UK has been divided into three Upper Air space Flight Information Regions through which runs a network of Upper Air Routes for both military and civil aircraft.*

Computer Aids for Air Traffic Control

Computers will be needed for future air traffic control systems. Experiments show that modified business machines can be used successfully for part of the operation.

FASTER aircraft and more of them—that has been the pattern of development in air transport in the past. And it looks like remaining so in future. From a control point of view this growth could be dangerous. Traffic control systems of the early '50s are not likely to be able to cope with air traffic in the late '60s.

It has been clear for several years that some form of joint control of civil and military aircraft will be necessary in the future, and that electronic data processing aids will be needed for this purpose. Much work on radar data processing has been done in Britain. It was started for military reasons but many of the techniques are adaptable for civil use, and will prove very valuable.



Input to the computer system may be either by way of the teletype or inserted by the card punch operator in accordance with a telephone message.

Applying data processing to the actual business of controlling civil aircraft, however, is a different story. The nearest thing to it in military flying is interception, where one aircraft is guided to meet another. This simple "one-off" type of problem is not met in civil flying. There the problem concerns a large number of aircraft flying in various directions, and the decisions taken for any one of them must be thought out with respect to the movements of all the others. The main requirements boil down to adequate high-speed storage and the right form of input and output.

KEEPING UP WITH REAL TIME

In Britain a great deal of thought has been given to the latter problem by the Ministry of Aviation. A critical appraisal of the present system of air traffic control has been under way for some time. Its aim is to streamline the system and pave the way for bringing in a computer. The main problem is recognised as that of incorporating a human operator in a real time electronic data-processing system. Work is underway on this aspect, for example in evaluating the effectiveness of the different forms of visual displays that can pass information to the controller. At the same time a computer is being made ready to assist in air traffic control of the North Atlantic control area.

In the United States considerably more experimetal work has been done. At Indianapolis Air Route Traffic Control Centre, for example, a programme of work with a digital computer has been in progress for about three years. Some of the results obtained are set out in Report PB171040 "Programming IBM 650 RAMAC. Computer for Data Processing in an Air Route Traffic Control Center," by H. R. Johnson, Jr., J. E. Erickson, J. E. Speers, and J. O. Egloff (originating from the Federal Aviation Agency). The experiments carried out at Indianapolis show the sort of work a modified business computer can do in this field.

In ATC centres, flight plans received from pilots are processed and marked up on flight progress strips for the controller's display board. A flight progress strip is prepared for each navigation fix over which a flight will pass. Manual preparation of these strips is a time-consuming task, and during peak periods the assistant controllers are frequently so busy with this task that they have little time to assist the controller.

The routines developed for the IBM 650 RAMAC system amounted to: preparation of flight progress strips, storage of flight data in the computer, modification and updating of stored data, and the forwarding of flight data between centres and to Air Defense Command. Thus the computer was not being used to evaluate possible collision situations, this remained the work of the controllers. The Indianapolis centre is one of 30 similar centres in the United States. It is responsible for an area about 350 nautical miles long, east-to-west, and 250 nautical miles wide, north-to-south.

The area contains more than 125 airways, with a total length of more than 15,000 miles. In many cases, these overlap each other for some distances. A total of 54 principal navigation aids define the airways. Approximately 80 per cent of the flights through the area are along them. The remaining 20 per cent of the flights are from point-to-point by direct routes, or by a combination of airway and direct routes.

Flight plans filed with Indianapolis are received by teletype, telephone, and direct radio communication. They contain flight identification, aircraft type (and number if more than one aircraft is in the flight), airspeed, or ground speed if flight is active, altitude, point of departure, route of flight, destination, proposed time of departure or entry fix, and estimated time of arrival over the fix.

The equipment installed at Indianapolis is shown in the diagram. The flight plan originates either with a telephone message to a type-826 operator, who punches a card and puts in in a station from which it is hand carried to the type 407 operator; or it originates with a teletype message, which is converted from teletype tape to an IBM card by the 047, and hand carried to the 407 operator. When the operator has entered the card into the hopper of the 407, the on-line machine reads the flight plan from the card into the 650, where it is processed by a stored programme.

All arithmetic operations are performed in the 650 arithmetic registers. On command of the stored programme, the 407 prints flight progress strips. The 838 inquiry typewriter is used for special input messages and for special output messages. For instance, cancellation of a flight plan would go into the computer through it.

A more recent installation in the United States uses separate printing heads at each of the controller's positions. In Britain it seems that electromechanical indicators may be preferred to printers; the reason is that it is not clear whether it is possible to have check-back facilities between the information printed by the individual heads, and it has not been proved that radar controllers can operate effectively with such displays.

INPUT ROUTINE

The computer, using a small group of branch instructions, determines whether there is any computer input. The input may be from one of the inquiry typewriters, the type 533 read-punch, a check of the time on the clock, or from the 407 accounting machine. As long as there is no information to enter the computer from any of these sources, the computer will repeat this series of instructions. When there is a card in the 407 card hopper, the answer to the 407 branch instruction "Is there 407 Input?" changes to "yes," and the computer begins the Input Routine to start processing the flight plan.

The Input Routine organises all incoming flight data, which then is used by the Airway Routine and the Direct Routine. It is capable of determinining some types of errors in the flight plans which enter the computer. These are principally errors in the length of an item, or in its alphabetic and numeric composition. After converting the input information into the appropriate form and entering it into the store, the Input Routine causes a transfer to either the Direct Routine or the Airway Routine.

The Direct Route Routine processes and prints flight progress strips for all the fix postings required on direct flight plans and also on direct segments of combination direct and airway flight plans. Any type of fix designation, fix identifier, longitude-latitude, relative direction, or rho-theta, is accepted by the direct processing routine. Flight progress strips for either *en route* or proposed flight plans are printed in the appropriate format. Winds aloft are taken into consideration in the computation of estimated times of arrival and of plus time. All information required for strip printing not provided by input is computed by the Direct Routine.

The Airway Routine processes the flight progress strips for all airway route segments of a flight plan. It is capable of determining the direction of flight and whether the flight joins another airway without the junction fix being filed in the route of flight. Airway tables on the RAMAC furnish the airway routine with the information from which fix-postings flight-progress strips are prepared. The computations and printing of strips are carried out as the routine moves from fix to fix within the segment.

The machine-produced strips are neater and more readable than handwritten strips, and experience shows that some of the errors in handwritten strips have been eliminated by the machinery, namely, ten-minute errors, hour errors, insufficient postings, and incomplete information.

In April, 1959, the system was processing 94 per cent of the flight plans. It then took an average time of 10 seconds to process a flight plan. Faster programming and operation would have been possible if the amount of fast access storage were increased. Only 2,000 words could be stored on the drum for quick access at any one time. Modifications have now increased fast access storage to 6,000 drum words and 120 core words.

Human Element

Removing a London Bottleneck

A £200,000 road widening scheme by the London County Council for a part of High Holborn (which in another notation is A40 as it passes between Fleet Street and the Strand to the south and Grays Inn and Bloomsbury to the north) has been given a Ministry of Transport grant of £154,000. The widening will be carried out on the south side, providing a 35 to 45 ft wide carriage-way.

The bottleneck section is that between Holborn Place and Chancery Lane where the present carriageway narrows from four to three lanes. The proposed widening will give four traffic lanes and two footpaths of more than 12 ft width. Traffic on this route frequently reaches a level of 2,000 vehicles an hour.

Redevelopment of the property on the south side makes possible the present widening scheme. When redevelopment to the north is complete a second stage of the widening will be initiated giving an overall width of 65 to 70 ft.

The LCC has had primary powers for the widening since 1948. The present scheme has been designed in the offices of the Chief Engineer to the Council, Mr. J. Rawlinson.

Progress on Car Firms' Human Relations

Later this month representatives of the employers and of the unions with members in the motor car industry will be assembling again at the Ministry of Labour to agree on a joint statement on the talks on industrial relations. It will include a statement on the proposed action to be taken.

It is on this last part that the greatest attention is likely to fall. Two of the most important issues are the way in which vehicle industry workers are paid and the efficiency, or otherwise, of negotiating machinery.

At Luton, Vauxhall's have a long record of good relations within the "team" and there is a widely held belief that this may be due to a considerable degree to their payment system, which is based on a time rate allied to a bonus scheme. Another way of calculating the weekly pay packet is the British Motor Corporation's piece rate system, and the BMC's industrial record could almost be described as an illustration of the opposite of Vauxhall's.

Intentions for the future in the field of dispute negotiations seem to be rather towards making the machinery smoother working and more efficient rather than going in for wholesale revision. It is a common experience in a big motor works, when a dispute has broken out over a change in ways of working, to find that men have joined the strike after being told totally untrue accounts of what the change is to be. If the effective communication of new steps, and management thinking in general, can be brought about, a good deal less trouble may be met in the future.

On this score the motor industry may have a good deal to learn from some of the process industries and from the steel companies.

It will be interesting to see what more emerges on the employers' plan to give shop stewards training courses with paid time-off. Any furthering of knowledge about the company's plans, its difficulties and ways of thought is an advance. But the realities of local industrial politics, which have produced the two-tier set up, with the union officials at one level and the shop stewards at another, could go on to a third tier. We should then have the union officials, the "company trained" shop stewards and the "independents." Confusion would appear probable.

Morris Motors Returning to Overtime

From 15 April there will be Saturday morning overtime again for 1,500 workers at Morris Motors, Cowley, Oxford—a measure of the extent to which the industry has recovered from the winter doldrums. At the end of last month Morris were recruiting again, the first time they had been looking for new men since the beginning of the recession last atumn.

Throughout the months of short time working BMC contrived to avoid redundancies but, inevitably, the number of men leaving rose above the usual and recruitment was suspended.

Increasing demand, due to the ending of doubts on hire purchase changes and the traditional upswing brought about by the improving weather, has been supplemented by fresh orders from the United States for the sports cars. This is removing the last traces of short time working from the 800 strong MG factory at Abingdon. The Saturday morning overtime is to be worked on the Morris Minor and Mini-Minor lines. Ford, at Dagenham, and Vauxhall, at Luton, had already returned to overtime.

Standards Take Over Pre-Delivery Servicing

At Coventry, International Standard-Triumph are leading the way back to the pre-war practice of the car manufacturer assuming responsibility for the condition of the new model as it reaches the customer.

Since the war it has become the general practice for the dealer to carry out the servicing of cars, making certain that faults were corrected before the model was handed over to its buyer. Now, using their new £2½ million assembly hall, Standards are to conduct more exhaustive tests of each car as it approaches completion. Faults, whether mechanical or in the body, will be corrected at the works, producing a car which, in the words of the Standard managing director, Mr. Alick Dick, "Will be in every way ready to be handed over to the customer."

Dr. Beeching's Place Filled on ICI Board

Mr. Harold Smith, currently chairman of Imperial Chemical Industries' general chemical division, is to become technical director of the company from 1 June, in succession to Dr. Richard Beeching. As has been announced, and passionately argued over, Dr. Beeching is to become the £24,000 a year chairman of the new British Railways Board.

Industry and the Landscape

At a time when Cornwall is trying to encourage industries to come and live in the Duchy, it seems incredible that a proposal to reopen a derelict tin mine should meet such fierce opposition from a small group that the Minister of Housing and Local Government has had to step in. But such is the case with the Carnelloe mine project, plans for which were put before the local planning authority last summer by a local mining engineer. From the severity of the storm of protest one would imagine that instead of a small and unobtrusive mining plant, the sponsor was proposing to build a power station or a chemical works.

In point of fact the little Carnelloe mine, perched on the edge of the cliffs in one of the loneliest spots in Cornwall, would be totally invisible from the nearest village, Zennor, and quite unobtrusive. Geological indications are that should the property turn out to be worthy of large-scale development, it would not be in a landwards direction but out under the sea like the once-famous Levant and Botallack mines standing derelict further west, and the Geevor concern still operating.

The vociferous local objectors appear to be mainly artists who have gone to live in Cornwall, and who presumably know little of the wealth of mineral deposits and the tradition of mining skill latent in the county. Although active mining operation there is now only a pale shadow of its former self, in former times it brought a prosperity to Cornwall unparallelled by the holiday industry of today. If the need for tin from local resources ever again becomes acute, as experts predict it will, then Cornwall should be the first to reap the benefit.

Now that the Minister has decided to settle the issue himself he has ordered a public inquiry, to be held in Penzance on 10 May.

Apathy Towards British Mineral Resources

The Carnelloe mine objectors have possibly overlooked the existence of the Cornish Mining Development Association, who take the view that here is a test case that must be fought—and won.

The CMDA was formed thirteen years ago "to foster, encourage, develop and protect the metalliferous mining industry of Great Britain in general, and of Devon and Cornwall in particular."

Britain's manufacturing industries depend upon an adequate supply of base metals such as tin, tungsten, lead, zinc, copper and arsenic. All these and other non-ferrous metallic minerals occur in quantity in this country; and yet Britain, alone of the great powers, discourages the development of her own mineral resources despite the fact that the world's reserves of these metals are being depleted much faster than new discoveries are being made. The position for tin in particular, in which Cornwall is rich, is becoming increasingly critical.

The CMDA have tried by every available means to bring this state of affairs to the notice of successive British governments, but so far without any results. By its adherence to a penal, and in view of the small present size of the industry, unnecessary, system of mining taxation, Britain continues effectively to discourage the revival of an industry which, in other countries, is being actively assisted by tax concessions. And as the last straw, the new re-rating proposals are likely to place a further burden on the few remaining companies still miningt in.

Under such discouragement it is gratifying to find that private enterprise is showing increasing interest in Cornwall's mineral potential. It is believed that a considerable proportion of it lies beneath the sea, and teams of geologists armed with diving equipment have recently been exploring undersea rock exposures at several points off the north coast with promising results.

In the meantime the CMDA is continuing the fight against public apathy towards British mineral wealth and the Carnelloe mine inquiry might well turn out to be the turning point in their efforts. For the great awakening to wait until industry start finding themselves unable to obtain their basic raw materials would be too late.

Venetian Beauty and Island Advance

Comparisons between Venice and Isle of Wight would be far fetched at the best of times. Now, for good reasons in both cases, it looks as if the two may go off in opposite directions in their future development.

On the Adriatic, the Italian Government public works council, agreeing with the Italia Nostra (Italy's equivalent to the British National Trust) has thrown out a plan for a modern business centre in the city where Shakespeare's merchant operated, and has also turned down the proposal to build highways across the lagoon. All the proposed town planning measures protecting the historic character of Venice were approved.

On the Solent, the Isle of Wight County Planning committee have asked the county council to decide at the next meeting whether the island shall be connected to the Hampshire mainland—either by bridge or tunnel. Among the island's councillors it is firmly believed that a bridge or tunnel would be a major economic advance for the island and would pay for itself within a few years.

Back in 1955 the county council decided by a majority of one to cease discussion of a Solent bridge.

Production of Tin-in-Concentrates 1955-1960 (excluding USSR)

Continent	Production (long tons) 1960	1955	Chief producer	Production (long tons) 1960	1955
Africa	20,200	25,313	Congo	10,085	15,028
America	20,700	29,081	Bolivia	19,404	27,921
Asia	113,300	119,898	Malaya	51,979	61,244
Europe	2,800	4,357	UK	1,199	1,034
Australasia	1,906	2,017	Australia	1,906	2,017
WORLD TOTAL	158,906	180,666			
Cash price in London	£796·1	£740·1 per ton			

Traffic Rides Piggy-Back on Roller Roads

Separate electric motors driving rollers would power a proposed highway system designed to convey cars or commuters between cities at high speed.

A NEW concept in mass transport—a high-speed electrically powered highway system—has been proposed by the Westinghouse Electric Corporation. The system, which is illustrated in Fig. 1, is said to be adaptable for either cars or commuters. Described as a " roller road," it was conceived by two Westinghouse engineers, Mr. Charles Kerr, Jr., of Pittsburgh and Mr. Clarence Lynn of the company's motor division in Buffalo. It is claimed that the system would transport automobiles and their occupants piggy-back fashion at speeds up to 150 mph and commuters at speeds up to 75 mph.

The " highway " would comprise a series of rubber rollers, similar to inverted roller skates, spaced about 20 ft apart and built on the ground as indicated in Fig. 2. The rollers would be powered by small individual motors. Flat-bottomed carriers would be supported and propelled by the rubber rollers.

It has been stated that the roller road could be put into service at an early date and would offer a means of rapid metropolitan and inter-city transport, so helping to solve congestion problems.

COMPUTER CONTROLLED

Mr. Kerr described the system as follows. The automobile-carrying vehicles would embody as little equipment as possible so as to minimise the risk of failures, which might lead to shutdown or delay. Each lane of the highway would be a continuous computer-controlled system of separately powered rollers, receiving electric energy from neighbouring interconnected electricity supplies. The roller system would not only serve as the highway surface, but would accelerate the conveyances, keep them moving once accelerated, and provide braking power at proper locations. The conveyances would be stopped at fixed stations where the cars would be loaded and unloaded automatically to achieve uniform loading in minimum time. The procedure may be gathered from Fig. 3.

Each carrier would be approximately 110 ft long, and provision would be made for 10 cars, with separate passenger accommodation. The carriers would be operated in strings of 3 to 10 units under normal conditions. The only factor limiting the number of carriers would be the length necessary for the loading platforms.

Guide rails on each side of the roller-road would steer the carriers along the rollers. Guiding wheels, operating against the rails, would be the only rotating devices on the carriers. These wheels could also be used to power generators for light and heat inside the carriers. The drive package for each roller would consist of a three-phase induction motor, a torque converter, a brake and a reduction gear.

INDIVIDUAL ELECTRIC MOTORS

The time required for a 1,100 ft string of 10 carriers to pass over a given roller at 150 mph would be about 5 seconds. Consequently the motors would work for five seconds and then be idle until the next conveyance came along. The motors could therefore be heavily overloaded for short peak intervals, permitting a considerable reduction in size. A mechanical brake would be included on each roller to provide for emergency stops anywhere along the highway.

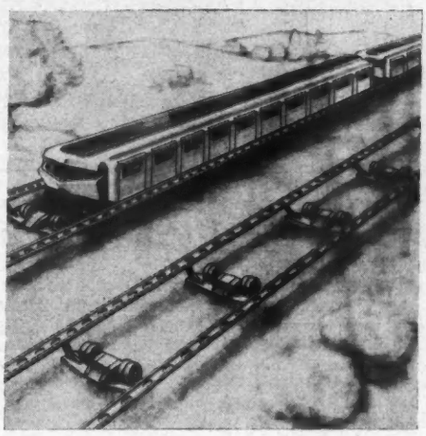


Fig. 1 High speeds and reliability are claimed for the roller road, an inter-city traffic system proposed by Westinghouse Electric Corporation.

AUTOMATIC LOADING

A loading and unloading time of one minute was set as a goal in order to maintain an average speed of 120 mph over the highways. A driver intending to board a carrier would place his car on a dolly at a platform adjacent to the highway, and would take no further action until he and his car were automatically unloaded at his destination. Computer controlled lights would indicate to a driver which spaces were empty on the approaching carrier. When the carriers stopped, automatic devices attached to the station platform would raise the proper doors on each side of the carriers. With the doors raised, a mechanical device would push the dolly and the car on to the carrier. The corresponding dolly on the carrier, whether or not it carried an automobile, would be pushed off the carrier on to the other side of the platform.

" Consideration was given to the possibility of people driving automobiles on and off the carriers," Mr. Kerr stated, " but this was discarded because of the uncertainties of human behaviour."

HIGH SPEED TRANSIT

Mr. Kerr said the computer control for the system would dispatch strings of carriers at proper intervals; provide protection against rear-end collisons should any string of carriers be stopped; and control the automatic loading and unloading at stations. He pointed out that the major problem in an automatic system designed to handle the tremendous traffic of modern motorways was that of reliability in the propulsion system. While the roller-road concept naturally introduced many difficulties it offered the only propulsion plan which seemed to offer the reliability needed to make a high-speed system of this kind workable.

Mr. Kerr listed the following advantages of the system:

(1) It could handle conventional traffic at twice the speed.

(2) It capacity could be increased with little expense by running more than ten carriers together as an operating unit.

(3) It could carry high-class freight in containers at speeds comparable to those of airline traffic.

(4) It offered an all-weather route, invulnerable to delays from fog, ice, sleet or snow.

(5) It could carry passengers who may desire to travel without their automobiles.

(6) The same principles could be used to provide an excellent rapid transit system for large urban communities.

If the Westinghouse proposals were adopted in Britain in conjunction with those of the General Motors Corporation (See ENGNG., 14 Oct. '60, p. 506), who would take the initiative—British Railways or a supra-authority for roads? The GM system for urban roads suggests an embedded electronic system which controls steering, speed and vehicle spacing.

Fig. 2 (below) Individually powered sets of rubber rollers would propel flat bottomed trucks incorporating a minimum of equipment.

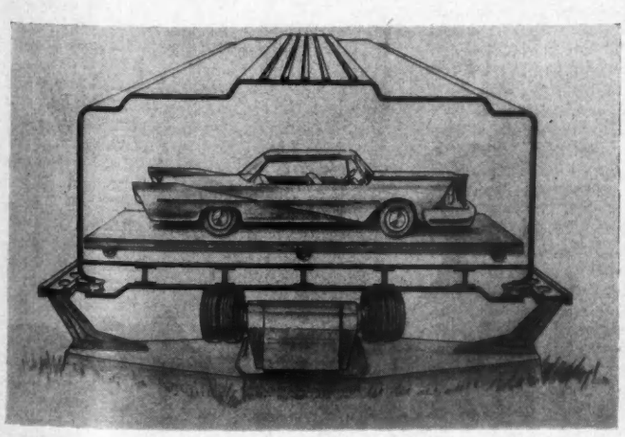
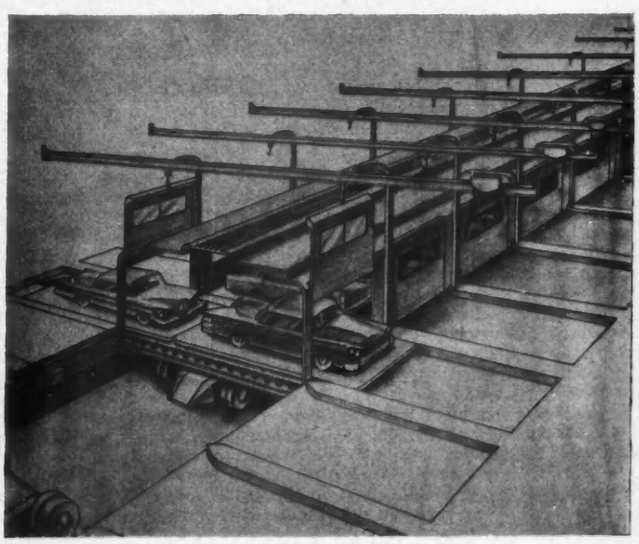


Fig. 3 (right) After driving his car on to a dolly at the side of the track, the driver need take no further action until after automatic unloading.



Suspension Bridge Over the Tagus

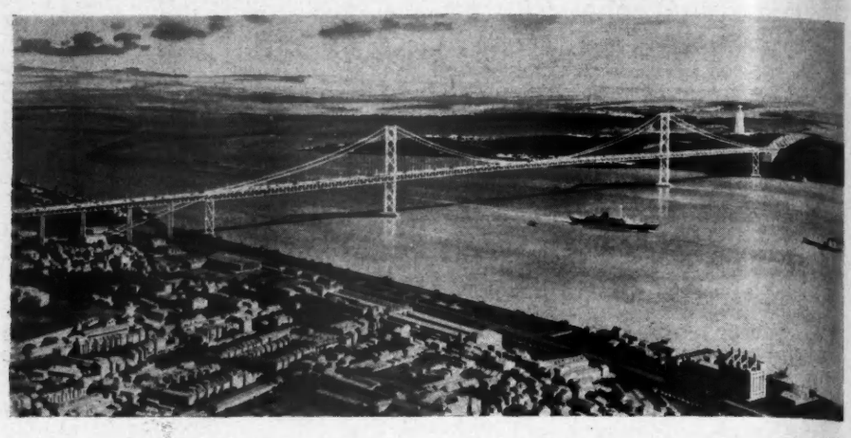
What will be Europe's longest suspension bridge —it will have a clear main span of 3,318 ft—is to be built across the River Tagus at Lisbon, Portugal, by the United States Steel Export Company of New York. It will be a four-lane road bridge with provision for the addition of a double-track railway.

The length of the bridge from anchorage to anchorage will be 7,428 ft, with the main span of 3,318 ft and the two side spans each of 1,540 ft; including access roads, the whole project will involve the construction of more than eight miles of road. The deepest pier will be founded on bedrock 270 ft below water level; the depth of water at the site is 90 ft. The anchorages are to be mass concrete structures.

The main steel towers, which will support the central span 230 ft above water level, will have a height of 625 ft. Fabrication of the structural steelwork will be done by the American bridge division of United States Steel but also participating in this work will be the Portuguese firm Sociedade Reunidas de Fabricacoes Metalicas, Lda, (Sorefame).

Construction of the piers, anchorages and approaches has been let to International Morrison-Knudson Company, Inc., and its French associates, Compagnie pour l'Etude et le Developpment des Echange Commerciaux (Compadec), specialists in deep water work.

Consulting engineers for the bridge are Steinman, Boynton, Gronquist and London, of New York City, and the Tudor Engineering Company of San Francisco.



Blasting Experiments to Study Effects on Buildings

A continual problem associated with blasting operations is the possibility of damage to nearby buildings. In many cases building owners become aware of cracks and similar defects after blasting operations have taken place, and a discussion then ensues about the cause.

An opportunity to gain reliable information about building damage known to result from blasting arose when the St. Lawrence Seaway-Power Project necessitated demolition of a large number of buildings in the area to be flooded. The Hydro-Electric Power Commission of Ontario and the National Research Council of Canada collaborated in a series of experimental blasting operations around some of these buildings. The results of the study have recently been published as *Experimental Blasting Studies* (NRC 5792); copies may be obtained by writing to the Publications Section, Division of Building Research, National Research Council, Ottawa.

The buildings used for the tests were all fairly old, in good condition and constructed mainly of heavy masonry. Some were founded in soft sandy clay soil and some in dense till. At each building a series of single charges was set off, increasing in magnitude until minor damage was produced. Charges ranged from 50 to 750 lb of dynamite at distances of 25 to 200 ft from the buildings under study. Vibrations in the adjacent soil and in the buildings were observed during each test in an attempt to find a relation between vibration amplitude and the development of damage.

The ground vibration measurements showed a well-defined threshold value above which damage could be expected. Approximately the same threshold was found for both types of soil though the pattern of damage was different in the two cases. For the buildings situated on soft sand-clay soil, the first evidence of damage was settlement with vertical cracking and differential movements in the foundations. This resulted in secondary deformation in the superstructures, marked by plaster cracking and eventual sagging and dislocation of walls and floors. Buildings founded on the hard till showed little settlement but direct evidence of the vibratory stress was to be seen, especially in the basements of the buildings.

Spalling and dislodging of stonework from the inner surfaces of basements were always early signs of damage. Eventually severe cracking occurred in the basement walls nearest to the blast source, especially where they joined other major portions of the structure. Generally the superstructure showed little obvious damage until very high blast intensities were used. In both cases a forerunner of damage was the dislodging of loose objects from shelves and loose bricks from chimneys.

The results obtained in the St. Lawrence experiments indicated approximate relations between weight of charge and distance from buildings for safe blasting operations. Safety rules based on such data are necessarily conservative, to cover the wide range of soil types and special features of the ground. A more precise procedure is to monitor the operations with a vibration measuring device. By measuring the vibration produced by a relatively small charge the safe limit can be determined for a particular area. Further studies are planned especially of buildings founded on rock. Simple procedures for monitoring vibration amplitudes will also be tested.

Low Pressure Stowing in Mines Pays Off

Low pressure stowing of waste stone in coalmines, with the compressor working at only 15 lb per sq. in, has proved to have a number of advantages over higher pressure operation, even though good results have been obtained over several years with the latter method.

With the low pressure technique, much smaller power consumptions are involved, thereby making for lower costs; inbye compressors are used instead of the general airlines of the colliery, so control of the machine is better, again making for a reduced power consumption. The production of airborne dust, which depends on the volume of air used when stowing, is also much reduced, enabling dust concentrations to be kept as low as possible. Since, too, inbye compressors are used, the stowing machine is placed near to the working face and the length of the stowing column can be kept small.

After preliminary experiments, the National Coal Board narrowed their requirements for low pressure stowing to the following: a compressor sufficiently compact for working inbye, of about 150 hp and giving free-air delivery of 2,250 cu. ft per minute at 15 lb per sq. in; air cooling was also desirable. The intention was to use this compressor with both a Markham Direct-on-Face and a Brieden KZS 50 stowing machine.

The first compressor answering to these requirements to go on trial has been an Atlas Copco screw type machine, the U 18. Connected to a Brieden stower, it began its trials at Pentalla Colliery, near Cardiff, last September. Standard 6 in bore stowing pipe was used with a total length of 180 ft, including one 180° bend. Under these conditions, a throw of up to 30 yards was obtained while stowing at a rate of 80 tons per hour and giving a pack having a density of 83 lb per cu. ft. Modifications enabled the noise to be cut down until it was possible to stand and talk in a normal voice only 5 or 10 ft from the machine. Both intake and discharge silencers were fitted.

A second trial was made at Cadley Hall Colliery in Derbyshire on a longwall face. The face, 120 yards in length, is completely stowed every two days. The rate of advance is 5 ft every two days and the height of the seam varies between 6 and 7 ft. Stowing time totals 4 hours per day. In each complete two-day cycle, 465 cu. yd of debris are being stowed.

The screw type compressor has several advantages for use below ground. Having few moving parts, it calls for little maintenance. As the two rotors never touch, no oil is required in the compression space and oil-free air is delivered. It is also claimed that experience has shown that screw compressors are more or less unaffected by the presence of airborne grit particles in the intake air.

Carbon Disulphide Causes Piling Danger

During the construction of foundations for extensions to a factory making cellulosic packaging films, the seepage of highly explosive carbon disulphide gas, used in other parts of the factory, made piling dangerous. The impact of the piling hammer on the casing was liable, on occasions, to explode the gas, flames shooting as much as 30 ft into the air. To prevent these explosions, carbon dioxide gas was forced into the holes to form an inert blanket over the tips of the piles, thus excluding the air (and therefore oxygen) and eliminating the possibility of the CS_2 being burnt.

The factory, which is near Aintree, Liverpool, is now nearing completion by Holland & Hannen and Cubitts (North West) Limited. Costing £2 million, the extensions consist of eight buildings which have been built using precast concrete portal frames. Only six weeks after the decision was taken to use precast sections, the first members were on site and erected; the whole contract has taken about twelve months. External walls are of brick panels. Roofs consist of standard proprietary trough units, two being inverted at the ridge to take extra bars and concrete for wind bracing.

The main building of the extension is a new casting hall. The atmosphere in the hall will be hot and very humid and, because of the chemicals used, also very corrosive. A single drop of condensation falling on to the film during processing could break it, stopping production while the film is re-threaded. To eliminate this particular risk, a suspended ceiling has been added below the roof units, with a minimum slope of 12°, so that moisture will run down the slope and not drop on to the film.

The owners of the factory are British Enka Limited. The consulting engineer for the factory has been Mr. D. S. Grave, M.I.Struct.E., of 158 Thomas Lane, Broadgreen, Liverpool 14; and the architects, Harry Banister and Partners, 67 Rodney Street, Liverpool 1.

Concrete for Italian Dams

Research on concrete for use in dam construction, with the particular object of improving strength, imperviousness and lengthening life, has been receiving renewed attention in Italy.

Most aggregates used in Italy come from either crushed sedimentary and igneous rocks or alluvial deposits. Of the first group, aggregates from the calcareous rocks were found easiest to work but their generally rounded shape was found not to give good binding properties with mortars, especially as the stone was often found to have a clay film on the surface.

For many years Italian dams have been built with pozzolanic cement and ferric clinker, the pozzolanic cement being made by grinding Portland clinker with pozzolanic material from the volcanic regions around Naples and Rome. The usual addition of pozzolana to the clinker is between 30 and 40 per cent. At seven days the strength of the concrete so made is not so high as those made with normal Portland cement but in time they become stronger and have a high resistance to sulphates and to waters with a high carbon dioxide content. These cements also develop less heat of hydration and the heat is also well distributed with time.

Dry mixes are recommended with heavy vibration to obtain compaction. High frequency vibrators (9,000 to 12,000 strokes per second) are always used, with a ram diameter of more than 100 mm (4 in). For dams where the stress is expected to exceed 50 to 70 kg per sq. cm (720 to 1,000 lb per sq. in), 250 kg (325 lb) of cement are used per cubic metre of concrete, with a water/cement ratio of 0·44.

Plastifiers and air entraining agents have become standard practice and the experience of the last 20 years has shown good structural wear. Thousands of samples are said to have been taken and over 90 per cent of the samples are claimed to have been "absolutely impervious." The absence of cracking has been considerably improved by the use of air entraining additives with pozzolanic cements. (*European Technical Digest No. 4137*)

Steel Bridge Floated 360 Miles to Site

A prefabricated welded steel bridge weighing nearly 200 tons has been floated from the River Tees works, where it was made, 360 miles around Britain's east coast, up the Thames to the Regents Canal Dock. The journey took three days.

The bridge just after it was launched from Head Wrightson's works.

The bridge deck was made by Head Wrightson Teesdale Limited and was designed as a seaworthy pontoon. This enabled it to be completed in the shops and brought to London without jamming the roads. It repeats the process that the company used when they made the heat exchanger shells for the Bradwell nuclear power station and similarly launched them into the River Tees to be towed down the coast.

The unit is for a swing bridge of box type construction, 135 ft long by 32 ft wide. It will carry both pedestrians and motor traffic over the entrance to the dock. British Waterways are sharing the cost, £80,000, with the London County Council. The civil engineering subcontractors are W. and C. French Limited and Sir William Arrol and Company Limited the machinery subcontractors. The consulting engineers responsible for the design are Husband and Company, of London, SW1.

Nailing Roofing Felt to Lightweight Screeds

The self-locking nails that were introduced last year, called Venales, have now proved themselves in practice. At Nottingham University, more than 150 gross were specified for roofing work to be carried out by the Weatherall Roofing Company Limited using the Nuraphalte method. The architects are Sir Basil Spence and Partners; the consulting engineers are Ove Arup and Partners; and Richard Costain Limited the main contractors. The roof is to extensions to the University.

The Weatherall Company are specialists in the laying of Nuraphalte thermoplastic roofing sheets which are welded at the joints to give a watertight covering. It is said that they have found Venales superior to any other fastening for use with their system. At Nottingham, the Nuraphalte is laid over Siporex lightweight concrete.

The Venale principle is simple. The rustproofed steel pin has a triangular section and is bifurcated (the two legs nesting one within the other and the top loop forming the head, rather like a split pin). The final blow of the hammer flattens the head against a prepunched fibre roofing disc, causing the shorter leg to clinch its foot outwards and upwards into the decking material.

Venales were specially designed for fixing roofing felt directly to lightweight insulating materials, such as vermiculite concrete, high density woodwool slabs and foamed concrete. Their use is an extremely speedy operation and enables the roof to be covered almost immediately as it is not necessary to wait for the insulating screed to dry out. Holding strengths of 35 lb upwards can be obtained.

Standard for Cold Formed Sections

The use of steel sections cold formed from thin gauge plate sheet and strip is now well established for steelwork construction and the British Standards Institution have issued an addendum to BS 449 (1959) "The Use of Structural Steel in Building," entitled "The Use of Cold Formed Steel Sections in Buildings." The addendum can be obtained from the Institution (Sales Branch), at 2 Park Street, London, W1 (*7s 6d*, postage extra to non-members).

A parallel standard to the addendum is BS 2994 "Cold Rolled Steel Sections," which sets out the properties of many of the basic shapes in common use. The methods to be adopted for design are given in the addendum.

Steel sections produced by cold forming are usually lighter in weight than the same size of hot rolled section and are found sufficient for light loadings, so avoiding the uneconomic use of material. Such sections are particularly well suited for use as framing members in buildings.

Single Crane Erects 150 ft Roof Trusses

Only a single crane was involved in the erection of 150 ft span roof trusses for a new shed for the Port of London Authority at South West India Dock. This was made possible by the use of hollow tube for all the members of the truss with the exception of the bottom chord which is a rolled steel channel.

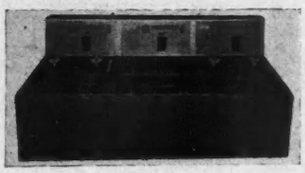
The whole of the roof structure for the shed, which is 311 ft long by 150 ft wide, was prefabricated at the Newport, Mon., works of Tubewrights Limited. The trusses were brought to London by road in three parts which were welded together at site. It is claimed that it may well be the first time roof trusses of such dimensions have been lifted by a single crane.

150 ft span bow string truss being lifted by a single mobile crane.

The shed is 31 ft high to the eaves and 45 ft to the crown. It has been clad in aluminium. The PLA designed the shed to their own specification and appointed Tubewrights as main contractor following the completion by the company last year of Britain's largest shed—commissioned by the United States Lines—at the Royal Victoria Docks.

PROPORTIONING EQUIPMENT

Programme Controlled



TEN OR MORE constituents can be fed by volume to form a final mix by a new automatic proportioning equipment.

EGO, the electronic grading operator, works on basic units of volume of the final mix, controlling the feed from fixed hoppers to a conveyor belt. The required mix by volume is set on a tablet and a push button starts the cycle. The separate units making up Ego can be housed as an entity or incorporated in a console or general control panel.

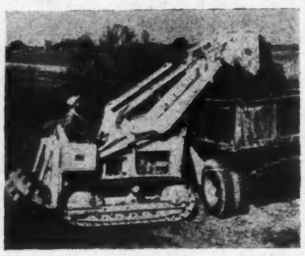
A unit generator produces pulses at unit delivery intervals and these pulses are transferred to a time scale, the unit distributor; which records and displays on the control panel the number of pulses generated from the start of the discharge cycle. Each container discharging device is contactor operated from a sensitive relay unit which can be plugged into the time cycle at any point through a programme selector.

Any required programme (mixture) can be set up on a tablet which consists of a Paxolin board measuring 7 in by 4 in by ¼ in with terminal plugs inserted at suitable spacings to cover the discharge control of all the containers. Inserting the tablet into the programme selector makes the necessary contacts and the programme is ready to start. The containers are spaced at intervals of one time unit so that there is a unit pause between the end of one discharge and the beginning of the next.

In addition to controlling the discharge gates, the unit distributors can be arranged to operate further relays for such purposes as chute changing and thruster operation. These functions are again initiated by the position of the plugs in the tablet. By appropriate plug position two batches can be mixed simultaneously. *Dewhurst and Partner Limited, Hounslow, Middlesex.*

CRAWLER LOADER

⅞ Cu. Yd Capacity



NOW AVAILABLE in this country is the John Deere-Lanz 10-10 crawler loader which has a bucket capacity of ⅞ cu. yd.

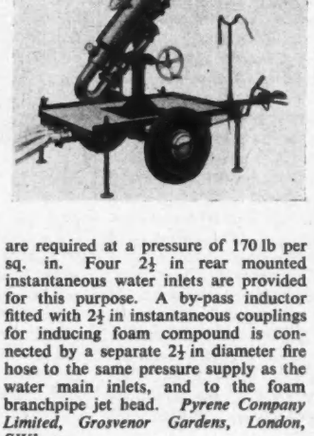
The four cylinder diesel engine is rated at 40 hp at the flywheel giving 27 at the drawbar. It is water cooled. The heavy duty transmission and final drive units provide a stepless speed range from 0·084 to 6·5 mph. The Revers-a-Matic drive uses hydraulic control to obviate declutching or stopping before changing direction in the same gear.

A joystick gives single lever control of the bucket which measures 66 in wide. The pump provides 20 gallons per minute and there is a hydraulic take-off point for rear end hydraulically operated equipment. An indicator shows when the bucket is in the dig or the level position. The dumping angle at maximum lift is 50° below horizontal and at ground level is 70° below horizontal. Roll back at ground level is 40°. Break out force of the bucket is 8,500 lb. A rapid cycle time is possible, raising taking 6 seconds, dumping 1·5 sec and lowering 4·5 sec. All oil lines are seamless steel tubing or double wire braided flexible hose.

The track and frames are identical with earlier models, the track area being 1,662 sq. in, and 12 in semigrousers are used. Multiple disc clutches and hand brakes are used for steering, giving the machine a turning radius of 6 ft 6 in approximately. A range of accessories is available for both front and rear end attachment. They include a dozer blade, a back hoe and an hydraulic ripper. The last replaces three of the five counterweights. *J. D. Tractors Limited, Maidenhead Road, Windsor, Berkshire.*

FOAM MONITOR

Jet 75 Ft High



A NEW dual purpose foam generating unit recently introduced is designed mainly for use in oil refineries, tank farms, tanker jetties, and chemical works and in fact wherever highly inflammable liquids are handled in bulk.

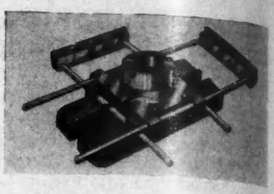
The Super-Jet unit is mounted on a two wheel trailer enabling it to be towed to site by any light commercial vehicle. It can be manhandled into final position. There are four drop legs to steady it while in action.

The foam generating unit projects a jet 180 to 200 ft long or 75 ft high in still air, so that the tops of 60 ft tanks can be reached. The monitor can be elevated to an angle of 45° and traversed the full circle by means of two worm and wheel mechanisms, each controlled by large hand wheels, ensuring flexibility in directing the jet.

This single unit will deliver up to 5,000 gallons per minute of mechanical foam or alternatively up to 500 gpm of water for cooling down purposes. For full foam production 660 gpm of water are required at a pressure of 170 lb per sq. in. Four 2½ in rear mounted instantaneous water inlets are provided for this purpose. A by-pass inductor fitted with 2½ in instantaneous couplings for inducing foam compound is connected by a separate 2½ in diameter fire hose to the same pressure supply as the water main inlets, and to the foam branchpipe jet head. *Pyrene Company Limited, Grosvenor Gardens, London, SW1.*

BOLSTER OUTFIT

To Accommodate Press Tools



THE ILLUSTRATION shows the frame for a bolster outfit designed to save tool costs on light press work.

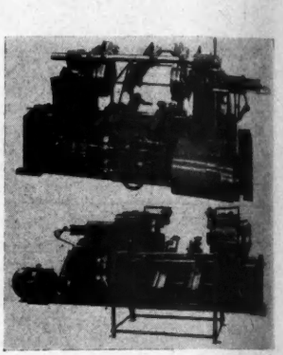
The frame is an iron casting weighing approximately 30 lb and measuring 14 in long by 6 in wide by 2⅛ in high. It is precision bored and has slots for bolting down to the press bed. The minimum distance between holding slots is 8¼ in. Two adjustable gauges are supplied for use at the back and side and these can be removed when not required. Swing-over gauges for multiple setting can be provided if required.

Five insertable die holders are supplied (one is shown about to be inserted) to take dies from ½ in bore diameter to 2½ in diameter. In addition there is a supporting ring for dies up to 3¼ in bore diameter. Punch holders are supplied for punches from ½ in to 3¼ in diameter. In addition there is a wide range of special tools for such operations as louvre piercing, corner notching, piercing and blanking squares and other shapes; also a range designed for radio and electronic apparatus chassis dimensioned to punch out for standard relays, valve holders, and plugs and sockets.

Punches up to 2 in diameter are made with shanks of the same diameter to fit the holder; larger sizes are bored with a central hole through which the spigot of the holder passes. Both types have a small centre point for locating on centre-punch marks in the work but can be supplied to special order with a locating spigot to engage holes previously drilled in the work. The louvre tools will form up to 8 in long and corner rounding tools are available with standard radii of ¼, ½, 1, and 1½ in, all on the one tool. Tools to other sizes and special tools for particular applications can be supplied to order. *Hunton Limited, Phoenix Works, 114-116 Euston Road, London, NW1.*

DRUM MAKING PLANT

Automatic



AUTOMATIC loading and unloading is a feature of a new drum making plant.

The complete equipment consists of three machines of which the flanger and seamer are illustrated. The third is the corrugator. The continuous output speed of each machine is 10 drums per minute for drums from 7 to 16 in diameter and 7¼ to 32 in long.

The plain drum bodies are conveyed to the automatic flanging machine which has two headstocks, one of which is adjustable for length. Provision is made for permitting an eccentric movement in the right hand set of flanging rollers to ensure that the pressure is applied along an even and parallel plane. Cams apply the pressure and can be varied to suit the drum diameter.

The latest station in the line is the type UR seamer. A versatile machine, it will produce a large variety of drums simply by changing the tools. In addition it is also possible to curl one end of the drum by replacing one seaming head by a curling attachment. The automatic feed on this machine is similar to that of the flanger, the right hand head being adjustable for drum length. The cams slide with the head and do not need resetting. The drums arrive at the machine with the end stampings already in place and rotate freely on rubber covered rollers. For watertight drums an accessory is available for introducing sealing compound. *Moon Brothers Limited, Beaufort Road, Birkenhead, Cheshire.*

UNIVERSAL MILLING MACHINE

Stepless Feeds

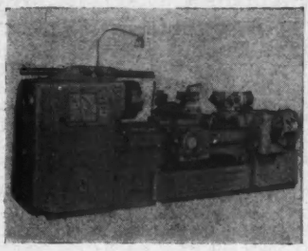
THE Schaffner universal milling machine type W12 is intended for both toolroom and batch production work.

The machine is built to Schlesinger limits. Stepless longitudinal feeds are provided ranging from ⅜ in to 5½ in per minute. The table stops are provided with fine adjustment and an accurate scale facilitates setting. The leadscrew drums are large in diameter and are graduated in 0·001 in. Table traverses are 17 in longitudinal, 5½ in transverse and 10½ in vertical.

The milling spindles driven by hardened, ground and lapped gears, are mounted on antifriction bearings, both horizontal and vertical spindle speeds being steplessly variable from 45 to 2,640 rpm. The short over-arm bracket can readily be removed for conversion to vertical milling. The vertical milling head is retractable on slideways to allow bulky work to be accommodated. It can be swivelled through 360°, accurate scales being provided on either side of the vertical position. Equipment can be supplied for slotting and spiral milling. *Dowding and Doll Limited, 346 Kensington High Street, London, W14.*

TURRET LATHE

Punched Card Controlled



THE TURRET LATHE RT8OP shown in the illustration is designed for punched card control. This machine is designed for export from Hungary. A hand operated model is also made.

The bore of the spindle of the machine is 80 mm and the maximum diameter of workpiece that it will handle is 550 mm (approximately 21¾ in) over the flat slideway. The maximum distance between the chuck and hexagon head is 1,250 mm (49¼ in). The lathe is driven by a 14 kW motor. The normal spindle speed range is from 28 to 1,250 rpm but a higher range available is from 35 to 1,600 rpm.

Spindle speed change is carried out by a hand operated electric preselection device for one-off jobs, or by a punched card for production work. The feed box supplies eight preselected feeds either by hand or again by punched card. The range of feeds can be further selected from the slide box to suit roughing and finishing work.

A lever-controlled rapid traverse saves time in bringing the turret into position, as also does the mechanical rotation of the head. Rapid approach is at 25 ft per minute.

On the punched card the main spindle speeds and feed values are marked in six rows. Out of the rows only that corresponding to the turret position is energised at any one time and the speeds and feed rates prescribed in the row in question will be engaged, the other rows remaining dead and out of operation. Apart from the equipment normally supplied with the lathe, there is a wide range of accessories. *Technoimpex Foreign Trading Company, Budapest 62, POB 183, Hungary.*

AUTOMATIC RESET TIMER

Multi-purpose

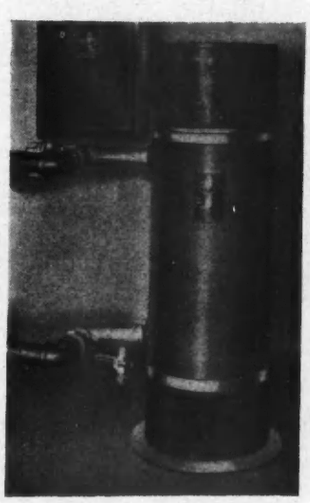
RECENTLY added to the range of time switches and process timers is the model PT5 illustrated.

This is driven by a synchronous motor and combines in the one unit a number of basic functions. The timing motor and operating contacts are brought out to separate terminals on a multi-way block, arranged in a semi-circle at the end of the casing. By appropriate connections the unit can be used as a delay relay, recycling process controller or a single operation process timer. A pair of contacts that close momentarily at the end of the cycle may be connected to another timer and used to initiate a second operation, and in this manner a group of processes may be carried out in sequence, so giving completely antomatic operation.

The pressed metal case is easily removable to provide access to the motor and internal wiring, and the timer can be flush mounted in any panel from $\frac{1}{16}$ in thick upwards. The dial is 5 in square and is black anodised aluminium with white lettering, and has a bright anodised bezel. Time setting is effected by turning the knob to the desired period. The centre disc revolves during timing showing the unexpired period, and returns to the set position on completion of the operation. All contacts are rated at 10A at up to 250V, or 5A at up to 500V ac. The timer is available for use on all standard mains supplies. *Venner Limited, Kingston By-Pass, New Malden, Surrey.*

ELECTRODE BOILERS

For Hot Water Systems



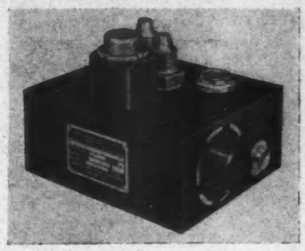
THE HVE series of hot water electrode boilers is intended mainly for thermal storage applications but can also be used in other installations.

They are designed to work at pressures up to 80 lb per sq. in and their thermal efficiency is better than 97 per cent. There are five models in the range with ratings from 60 kW to 300 kW and corresponding outputs from 200,000 to 1,020,000 Btu per hour. Operation is fully automatic and the control system can be chosen to suit each installation. Panels are available for wall or floor mounting as desired.

Automatic fault indication lamps are incorporated in the control panel and a mains failure protection device lowers the insulating sleeves to minimum before the boiler will restart, thus preventing surges on the mains. Large electrodes are fitted giving a low current density and consequently long life. With thermal storage systems the water is heated during off-peak periods and the heat released at a controlled rate during the day according to climatic conditions. *HVE Electric Limited, Viaduct Works, Kirkstall Road, Leeds 4.*

SERVO VALVE

Electrohydraulic Operation



A WIDE RANGE of hydraulic machinery can be controlled from an electrohydraulic valve developed from an aircraft unit.

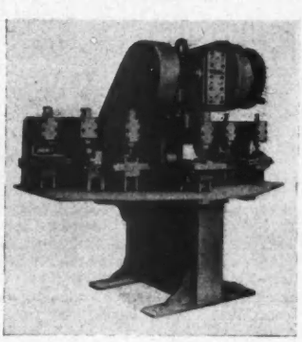
The unit consists of a combined main valve and pilot valve assembly and possesses two main features. One is that the pilot valve, which is in the form of a diaphragm between two nozzles or jets with a coil arranged axially around each jet, is substantially more free from vibration effects and is considerably more robust than the conventional torque motor. The second feature is that, by using this form of first stage with a conventional spool valve second stage, very high power gains can be handled.

The unit has a weight of 4½ lb and measures 4·5 in by 3·85 in by 2·0 in excluding unions. The coil resistance is 400 ohms ± 5 per cent per coil, and the inductance is 1 Henry at 1 kc/s. The maximum differential current is ±30mA, and the quiescent current 25mA. The flow with the load line short circuited is up to 8 gpm according to customer's requirements. Maximum supply pressure is 3,000 lb per sq. in and the servo pressure is 250 to 1,500 lb per sq. in. There is no external leakage.

When the currents in the two coils of the pilot valve are unequal, the diapragm will be displaced from its central position and the pressures of the two jets will be correspondingly altered. This difference in pressure is then transmitted to the spool of the main valve, causing it to move to one side and open or close the corresponding ports. As soon as the coil signals are again equal, the spool will return to the central position. *Armstrong Whitworth Equipment, Hucclecote, Gloucester.*

DIE PUNCHING MACHINE

Interchangeable Heads



THE USE of interchangeable heads allows the Edel VM35 multiple die punching machine to perform most notching and shearing as well as punching operations.

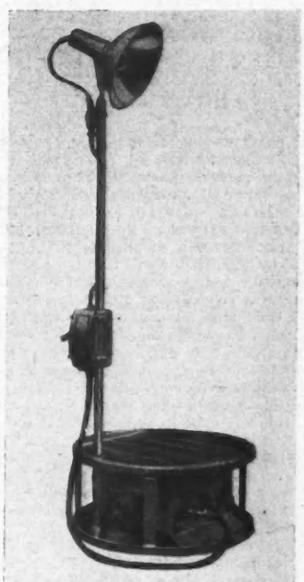
The heads are held by a quick action clamp so that tool changing is a matter of seconds; once set in the heads the tools need not be altered when the heads are interchanged. This greatly reduces setting time for jobbing production.

Drive to the machines is from a star delta motor to a balanced flywheel and totally enclosed reduction gears to the eccentric that operates the ram. Engagement of the clutch can be by treadle or hand lever; ram setting can be carried out by a hand wheel without the motor running, allowing accurate location for punching to a mark.

The range comprises five machines, the smallest having a capacity for 35 tons load with a throat depth of 7¾ in; the largest has a capacity of 100 tons and throat depth of 13¾ in. The smallest will punch a ¾ in hole in ½ in thick steel plate or alternatively a 2 in hole in $\frac{1}{16}$ mild steel plate. The cropping capacity is for 1 in diameter mild steel bar and for 2½ in by 2½ in by $\frac{1}{16}$ in angle iron. Larger machines can be made to order. The tool units are available separately. Special feed equipment, supporting tables and precision length stops can also be supplied. All component parts of the machine subject to heavy stresses are hardened. *F. J. Edwards Limited, 359-361 Euston Road, London, NW1.*

DISTRIBUTION DRUM

For Portable Power Systems



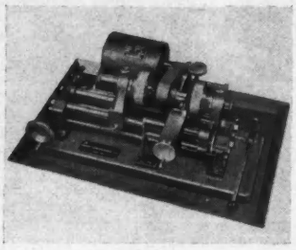
THE ILLUSTRATION shows a distribution drum for a temporary power system.

The box in the drum can contain fuses or circuit breakers according to the system requirements. For semi-permanent layouts the drum can be sunk in the ground leaving the lighting column projecting. The drums measure 33 in diameter and are 15 in deep. The case is mild steel with 1½ in angle rims, case and cover having a hot galvanised finish. Porcelain stand-off insulators on an insulating sub-base carry the bus-bars.

The electrical ratings of the components are for 100A 3 phase 415V and the inlet is a 5 pole plug. For outlets there are one 100A 5 pole socket, unfused; one 25A 5 pole socket, fused; and five 25A 3 pole sockets, also fused. The four bus-bars are made in 1 in by ¼ in copper and all earth poles are individually strapped to the drum, which has an external earthing lug. *Light and Power Accessories Company Limited, Wellesley Road, London, N22.*

COMMUTATOR LATHE

Turning, Undercutting



THE Com-Centric lathe is designed for turning and undercutting commutators on a one-off or production basis.

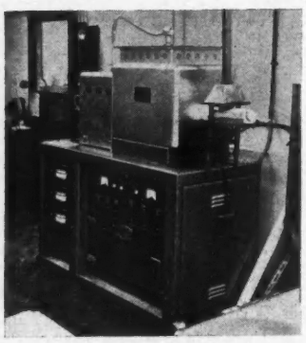
The model illustrated will take armatures up to 6 in diameter and commutators up to 4 in diameter with bearing journals up to 1 in diameter and 9 in between journals. Any length of shaft extension can be accommodated provided that the diameter does not exceed 1 in.

The machine is built on a swarf tray with bar form slideways supporting the main assemblies. The armature is held by means of its bearing journals between two self-centring three-jaw steadies, one of which is adjustable. A ½ hp motor drives the work by a flat belt passing over the armature. The motor carriage can be moved to adjust for belt tension and for changing drives from turning to undercutting. A bar mounted tool slide carries the tool which can be set by a handwheel in 0·001 in increments.

To undercut the commutator, the saw is driven from the motor by a round belt, the flat belt to the armature having been removed. The saw spindle is mounted in an adjustable bracket to allow the saw to be set for size of commutator and depth of cut. The bracket is on slide bars to allow for traversing under the control of a lever that is brought to the front of the machine. An adjustable stop is fitted to control the length of traverse. One advantage of the lathe is that both turning and undercutting operations can be carried out on the one setting. *Browning's Electric Company Limited, Boleyn Castle, Green Street, Upton Park, London, E13.*

DIFFUSION FURNACE

Controlled Temperature



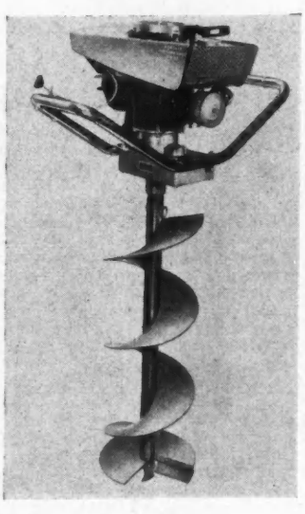
HIGH TEMPERATURE diffusion furnaces working up to 1,300° C to within exacting limits have now been produced.

The furnaces are self-contained units incorporating a floor standing cabinet which houses all the electrical gear. They are suitable for use with nitrogen, oxygen and hydrogen atmospheres and are designed to take work tubes of either impervious fused alumina or transparent silica having an inner diameter of 2 in.

Each furnace has a preheat and high temperature section, the former being mounted on wheels so that it can be moved to and from the main chamber and locked in position. The preheat section is 12 in long and operates between 200° and 1,000° C. Three separate heater windings are supplied from three variable transformers. The high temperature section is 15 in long controlled in one zone to temperatures from 950° to 1,300° C. Heating elements are silicon carbide and supply is from a single phase transformer. The temperatures of the two sections are independently controlled, two instruments controlling the preheat section with an anticipatory controller for the high temperature section. Rating is 7½ kW. There are even-temperature zones in both sections where the temperature can be maintained to within 2° C, and a fall in temperature cannot occur between these two sections. *Royce Electric Furnaces Limited, Albert Drive, Sheerwater, Woking, Surrey.*

PORTABLE BORER

Power Driven



HOLES UP TO 2 ft 6 in deep by 10 in diameter can be made with the Ebco portable power driven auger in less than half a minute.

The unit is designed for operation by one man and without the auger it weighs 29 lb. Power is supplied by a Clinton 2½ hp air cooled two-stroke engine which can operate at an angle of 45°. The throttle control is a press button in the handle and the automatic centrifugal clutch disengages at idling speed. There is a gear ratio of 17½ to 1 through an in-line drive, and the gears run in an oil bath.

Earth augers are available in diameters from 2 in to 10 in and up to 30 in long. Tree planting augers are made in a 9 in diameter size up to 18 in long. Extension shafts in standard lengths of 15 in are available for all sizes and types. In addition to the speed, it is claimed that the tool will drill clean holes in most soils. Typical applications are for tree planting, post holes, and fencing. A larger two-man model which will drill 14 in diameter holes is also available. *Earth Boring Machine Company, Lake Works, Portchester, Hampshire.*

DUMPING SEMI-TRAILER

Frameless Construction

OUTSTANDING stability during tipping and great manoeuvrability are two features of a new semi trailer now on the market.

The trailer is constructed without a separate frame thereby reducing weight and increasing payload. The absence of a frame also means that the pivot points for the tipping are wide apart, the full width of the track in fact.

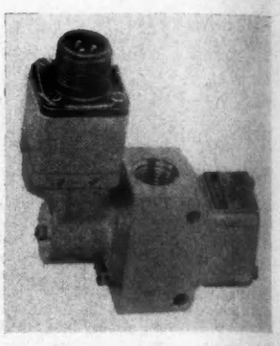
Tipping is effected by a single ram mounted at the pivot point of the fifth wheel with a radius rod on either side to steady the action and to form the links for haulage. The point of lift is above the centre of gravity of the load. Stabilising jacks (not shown in the illustration) support the semi-trailer when detached from the tractor.

The single ram lift avoids the hunting sometimes experienced with twin rams, and the articulation possible by its use gives the unit what is believed to be a unique feature, the ability to tip with the body at right angles to the tractor. Another unusual feature is that the trailer wheels and tractor wheels can be braked independently. As a result either the trailer is drawn up to the tractor when the tip is being made, or vice versa. It also enables the vehicle to free itself if one axle gets bogged down.

Bodies are made in 10 gauge steel or in aluminium, all welded, and from 14 to 24 ft long. Standard width is 84 in giving capacities from 8 cu. yd upwards. Tipping angle is 50°. Crane's standard 10-12 ton single axle, two axles in line or tandem axles are available. A medium automatic fifth wheel coupling to SAE-SMMT standard kingpin is used. *John Villiers and Company Limited, 69 Knightsbridge, London, SW1.*

PRESSURE SWITCH

External Adjustments



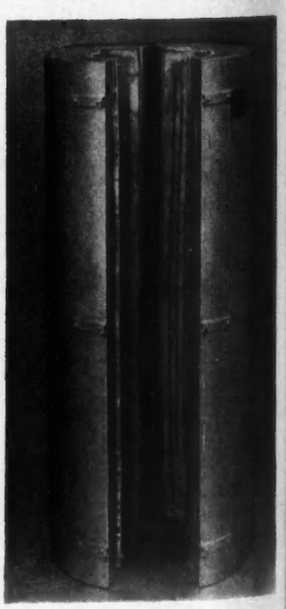
A NEW RANGE of Deltadyne pressure switches has external adjustment for the operating pressure.

These switches are suitable for system pressures up to 5,000 lb per sq. in and have an actuating differential pressure range from 15 to 200 lb per sq. in. Adjustment is by a calibrated dial on the base of the unit. The normal operating temperature range is from −65° F to +160° F but special models, for use with liquid oxygen, range from −320° F to +160° F. Standard models are made in aluminium; other materials can be supplied if required.

A feature of the design is the use of a magnetic detent arranged so that the switch is either completely actuated or completely disconnected. There is no intermediate position in which the switch can dither due to vibration occurring near the point of actuation. Light in weight, they can be used in airborne as well as industrial installations. The electrical system is entirely separate from the fluid. Resetting can be either automatic or by hand as required. Actuation occurs when the lower magnet has moved 0·05 in under the pressure difference, at which point the attraction on the upper magnet is sufficiently reduced to allow a spring to take charge, lifting the magnet clear and operating the contacts. In manual reset types, the magnet rises out of the attraction range and has to be returned by a push button. *Pall Corporation, 30 Sea Cliff Avenue, Glen Cove, New York, USA.*

HEATING JACKET

Element Temperatures up to 800° C



TYPE QJM Isojackets are designed to operate at element temperatures up to 800° C, corresponding to temperatures of about 600° C in the liquid.

They employ a quartz cloth heating surface of good tensile strength but which should be protected against friction. They can also be used where comparatively high loadings per sq. ft are required. For additional protection when used on production equipment, a steel wire mesh can be fitted over the quartz cloth.

A wide range of sizes is available with three loadings of 500, 700, and 1,000 watts per sq. ft. Standard lengths are from 12 in to 60 in in five sizes and diameters from 1 in up to 80 in, affording a range of heating areas from ¼ to 60 sq. ft. Standard loadings are reckoned for 220-240 volt mains, but models for 110V and for 50V can be supplied if required. The jackets can be provided with various forms of closures for the lagging boxes. *Isopad Limited, Barnet By-Pass, Hertfordshire.*

Neutron Exploration

Two new light-water moderated and natural-uranium fuelled subcritical assemblies are appearing on the nuclear market in this country. They are made by Vickers Armstrongs (South Marston) Limited and the Société Anonyme de Machines Electrostatiques (SAMES) of Grenoble, France. The latter company have now established a company in this country. Previously Miles Hivolt was the main firm for providing a subcritical assembly with this configuration (Atomic Review, 1 April '60 and 30 Jan. '59), but instead of using a steady state source a pulsed neutron source was used. The pulsed source enables transient experiments to be performed and greatly extends the use of the equipment. The first model made by Vickers-Armstrongs is being installed at Southampton University and will be in operation within the next few weeks using a polonium beryllium source. The SAMES assembly may use either a steady or a pulsed source.

Subcritical Assemblies Adequate for First Degree

For training the undergraduate, the expense of a low powered reactor is not warranted, since the experiments that can be performed on a subcritical assembly are sufficiently numerous and varied to give the student a preliminary introduction to nuclear physics. The advantage with the reactor is that it is possible to acquaint the student with actual reactor operation and control, and the possibilities for research are more varied and extensive. It has been whispered that the Ministry of Power is only going to allow a very limited number of reactors to be supplied to universities, and this may well lead the disappointed brethren to invest in a subcritical assembly which at least has the advantages of a reduced capital outlay. Such equipment would cost between £5,000 and £10,000 and the fuel may be loaned from the Authority at about £600 per tonne of natural uranium.

Details of the Vickers Assembly

A list of the design data for the assembly made by Vickers-Armstrongs is given in the table. The fuel elements consist of aluminium canned natural uranium slugs. The secondary containment provided by the aluminium tubes prevents water contamination by uranium fission and the ends of the fuel element tubes are filled with light water which acts as a reflector. The fuel is placed in a hexagonal configuration maintaining a homogeneity with all the fuel elements being equally placed; this cannot be achieved with a circular pattern. There is provision for 217 fuel elements arranged vertically and held in position by two grid plates near the bottom of the tank, so that it is possible to insert objects far down in the lattice without obstruction from the grid plates; these plates permit alignment to within 0·050 in. Additional holes provided in the upper grid plate facilitate the intergrid circulation of water acting as a reflector beneath the core. The fuel element tubes rest on the bottom of the containing tank.

The use of light water for the moderator together with the open construction of the assembly allows the insertion of foils, detectors and absorbers at any point in the core lattice. The assembly is driven by a polonium beryllium source which has a half life of 136 days. The fuel and irradiated source are obtained from the UKAEA. The fission process in the lattice enhances the neutron flux by a factor of nine, but the power developed in the assembly is negligible and the natural convection of the water moderator is sufficient for cooling purposes. A natural uranium and light-water moderated system is inherently safe and as the effective neutron multiplication factor is less than unity, there is no possibility of a nuclear excursion. The assembly is shown in Fig. 1.

Traversing Mechanism

The traversing mechanism shown in Fig. 2 is precision engineered to permit the location of the FC4 fission counter in any position in the lattice. The lateral position is determined by angular movement of the complete mechanism and radial movement of the saddle which supports the probe. The angular movement is controlled to 1/100° by means of a vernier scale, and radial traverse is effected by manual operation of a leadscrew which controls the lateral position to an accuracy of 0·01 mm. The FC4 fission counter is mounted at the lower end of a graduated probe, vertical movement being obtained by a manually operated vernier graduated friction feed. The fission counter is coated with uranium 235 and the probe unit has a detachable cadmium sheath so that a total neutron count may be taken when the sheath is removed.

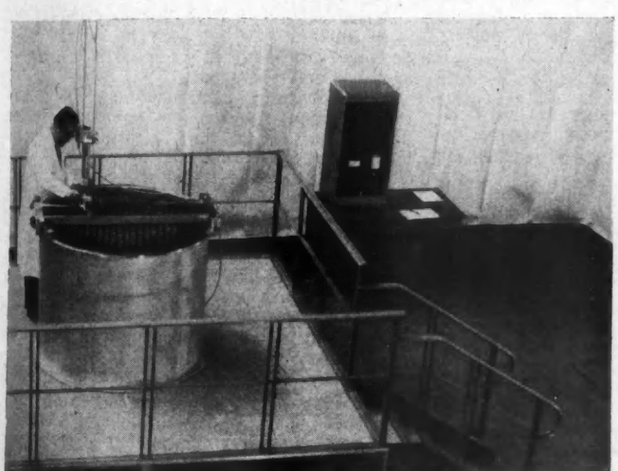
Foreign Entry to Subcritical Assembly Market

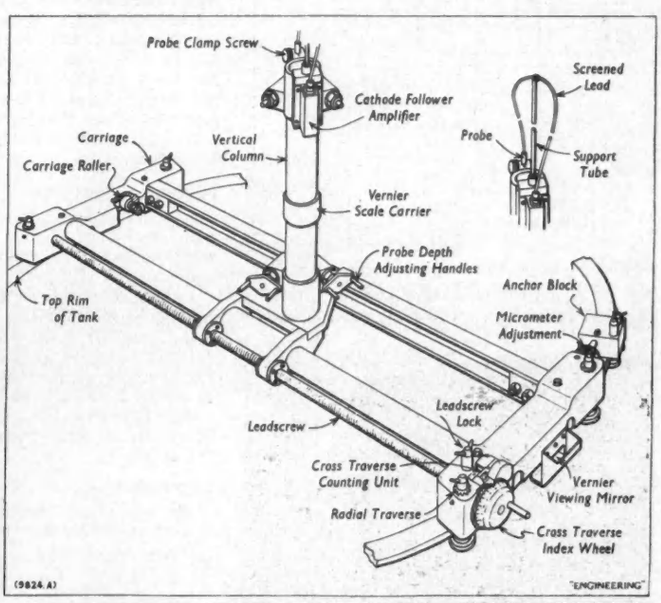
URANIE was the name given to a prototype subcritical reactor designed by the French Atomic Energy Commission and built under licence by SAMES of Grenoble. The reactor was first shown at the 1955 Geneva Conference on the Peaceful Uses of Atomic Energy, and is now available in this country through the British subsidiary of SAMES in London. URANIE II has been developed from this prototype to give more experimental facilities and a higher precision of measurement.

General Characteristics of Uranie II

The assembly consists of a hexagonal system of 163 natural uranium rods, suspended vertically in a tank containing natural water for the moderator. Various end plates can be provided if it

Fig. 1 (below) The subcritical assembly made by Vickers Armstrongs (South Marston) Limited which uses 1·8 tonnes of uranium and Fig. 2 (right) showing the traversing mechanism of simple design but giving a high degree of accuracy for the positioning of the fission counter.





Manufacturer	Vickers-Armstrongs (South Marston) Limited	SAMES
Overall dimensions	10 ft square including access staging less stairway	6 ft 9 in × 6 ft 9 in including staging
Fuel	Natural uranium	Natural Uranium
Fuel cladding	Aluminium	Aluminium
Location tubes	Aluminium—max. configuration number 217	204
Core horizontal dimensions	Hexagonal core 36·64 in across corners, 31·92 in across flats	28·4 in across corners. Pitch 1·77 in, 24·8 in across flats
Core height	3 ft approx.	44·6 in
Moderator	Light water (double distilled)	Light water
Reflector	Light water—minimum thickness 7·2 in (effectively and infinite reflector)	Light water
Containment tank:	Stainless steel	Transparent plastic (stainless steel is available if required)
Depth	5 ft 6 in	51·2 in
Diameter	4 ft 3 in	37·8 in
Capacity	340 imperial gallons	—
Fuel investment	1·8 tonnes—natural uranium	1·6 tonnes—natural uranium
Lattice	Consists of two grid plates which hold and position the location tubes	Two grid plates to locate fuel rods
k_∞	0·94	—
k_{eff}	0·82	—
Neutron amplification	9·0	—
Neutron source	Polonium-beryllium. Provision is made for small multiple source insertions	Sames Type J accelerator. 10^8 n/sec (either continuous or pulsed) Polonium-beryllium source (5 to 10 curies) Radium-beryllium source (1 to 2 curies)
Total weight	Completely assembled, including fuel and water—6 tons (approx.)	3 tons (approx.) completely assembled
Assembly support	6 in thick concrete base	Strong metal frame
Ceiling height	A minimum ceiling height of 12 ft is recommended	13 ft (without crane), 17 ft (if crane fitted)

is necessary to study different lattice geometries. The multiplication factor is less than unity, so that the reactor is completely safe, but the pitch is sufficiently small (1·77 in) for the Laplacian to be only slightly negative. The dimensions of the system are given in the table. The effect of control rods can be studied by replacing certain fuel rods by cadmium rods. The reflector medium is usually water, but a graphite reflector can be incorporated for certain experiments. The tank, which can be either of transparent plastic or stainless steel, is provided with water inlet and outlet tubes. These permit a circulating system of water heating to be used, in order to study the effect of moderator temperature.

The aluminium clad uranium rods are supplied by the French Atomic Energy Authority to all users of URANIE II, and they can either be rented or bought.

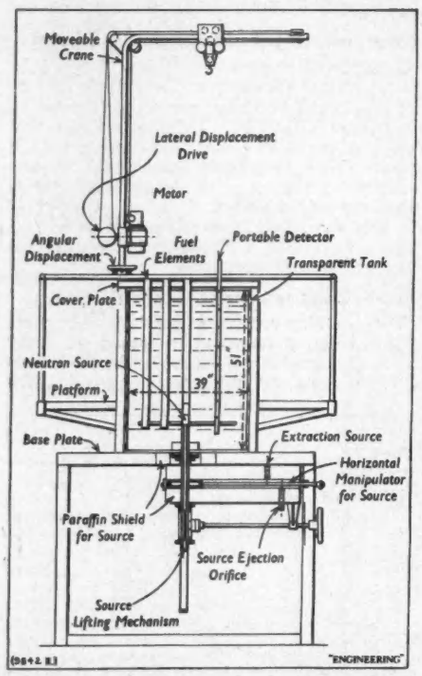


Fig. 3 Diagrammatic view of Uranie II, showing the mechanism for removing the neutron source.

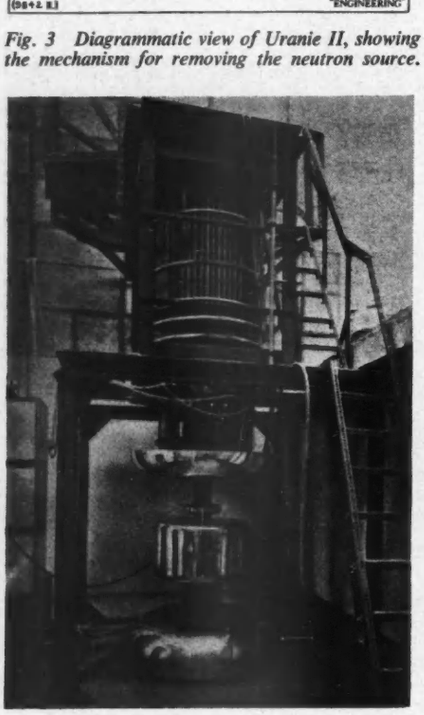


Fig. 4 The SAMES "Uranie" subcritical assembly, showing an electrostatic generator for providing a pulsed neutron source.

A neutron source of about 10^7 neutrons per sec is incorporated on the axis of the lattice at the bottom of the tank. Either a radioactive source or an accelerator can be fitted, but the standard version uses an accelerator.

Radioactive Source

A polonium-beryllium (5 to 10 Curie) or radium-beryllium (1 to 2 Curie) source is available, with a diameter of 15 mm. Usually the polonium-beryllium source is preferable in view of its lower cost and the absence of gamma radiation.

URANIE II is fitted with a mechanical device for manipulating the source shown in Fig. 3. In its rest position the source is held in a paraffin wax castle below the tank. A safety device with alarm bell prevents the source from being accidentally left in an intermediate position between the castle and the tank.

Electrostatic Accelerator

A small ion accelerator has been designed by SAMES to provide a continuous or pulsed source of neutrons. A Felici 150 kV electrostatic generator is used to drive the "J" type ion accelerator. The 150 kV deuterons impinge on a target at the end of a drift tube inside the assembly. The deuteron-deuteron reaction is used to give a neutron yield of about 5×10^8 neutrons per second of 3 MeV neutrons. The system using an accelerator is shown in Fig 4.

Using an accelerator with the assembly has the following advantages over radioactive sources: higher neutron fluxes can be obtained and these can be controlled; monoenergetic 3 MeV neutrons are produced; additional safety—all radiation can be completely switched off at will; pulsed neutron studies can be made, permitting kinetic measurements; and the accelerator can be used separately from the reactor, thus providing an additional research instrument for the nuclear laboratory.

Measuring Instruments

A number of access tubes are provided parallel to the fuel rods to permit neutron flux measurements. Two main types of detector are used:

Indium or manganese foils—these foils are mounted in a polythene rod which slides inside the access tube. Normally there are 10 foils with a spacing of 3·9 in, so that 10 readings of neutron flux can be made at different heights and at a fixed distance from the centre of the lattice.

BF3 counters—these can also be slid into the access tubes and more rapid measurements can be made.

Experiments

The type of experiment of interest to a teaching laboratory with a subcritical assembly would be:

(*a*) Drawing of flux map and determination of Laplacian. These measurements would be made using foils.
(*b*) Variation of buckling as a function of the lattice geometry and moderator temperature. It would be possible to replace the water with benzine or alcohol.
(*c*) Distortion of flux distribution caused by replacing natural uranium rod by slightly enriched uranium, or by replacing water reflector by graphite.
(*d*) Measurement of the multiplication factor.
(*e*) Criticality measurements.

Notes and News

Hawker Siddeley Close Langley Factory

The Hawker Siddeley Group announced last week that the factory of the Hawker Siddeley Nuclear Power Company at Langley, near Slough, would be closing down. The group's statement said that "the action had been forced upon the Hawker Siddeley Group as a result of the uneconomic trend which has developed in this type of industry." The work of the company includes the development of the Jason reactor from the original Argonaut reactor made by the Argonne National Laboratory (Atomic Review, 28 Oct. '60). Three different marks of Jason reactor are now available. Investigations have been made into the organic moderated reactor system and the company was one of the five firms to put forward proposals for the nuclear ship propulsion unit that is now being considered by the Government. A plant had been built for testing the organic fluid. Considerable research has been conducted on impermeable graphite and the furfuryl alcohol process was developed; last year it was offered commercially. The future of the 350 employees and the equipment is uncertain including the Jason reactor installed at the factory. However, the group's other nuclear factory at West Howe, Bournemouth, will remain open. About 150 people are employed there including 40 graduates. The factory is mainly concerned with contracts for the United Kingdom Atomic Energy Establishment at Winfrith.

Ispra for Euratom

The Italian Government formally handed over the Ispra Nuclear Research Centre to Euratom on March 23. The Ispra centre becomes the first major establishment of the Joint Research Centre, and so far the only general purpose centre to be set up by Euratom. Over 800 people are employed at Ispra, two-thirds of whom are technicians and research workers from the six countries of the Community. By the end of 1962 it is planned that the centre will have a staff of 1,500.

Accelerator Notes

Stanford University: A 10 to 20 GeV linear electron accelerator is to be built at Stanford University. The expenditure is expected to exceed $100 million.

Padua University: High Voltage Corporation is to install a new 5·5 MeV Model CN Van de Graaff accelerator in the research laboratory at Padua University, Italy.

Texas Science Research Institute: A three stage 17·5 MeV Tandem Van de Graaff particle accelerator is to be built at the new science-engineering centre of the University of Texas. The first of the three stages is a Van der Graaff accelerator which will inject high energy negative ions at 5·5 MeV into a two-stage tandem accelerator. In the tandem the negative ions are stripped of electrons and converted into positive ions which are accelerated further in the last stage of the machine. For intermediate bombarding energies, the 5 MeV injector and 12 MeV tandem can be used independently. The third accelerator, a 4 MeV unit, will provide intense quantities of monoenergetic neutrons for investigating the atomic nucleus and for general teaching purposes.

Reactor Notes

RC-1 Undergoing Modifications: The RC-1 (Triga Mark II) reactor at the Casaccia Nuclear Centre, near Rome, has been shut down since 20 January in order to make modifications after six months continuous operation. Addition is being made of an aluminium tank, lead internal shutters on the neutron beam tubes and placing of a lead curtain in the thermal column to permit biological experiments. The reactor will be operating again shortly.

Australia to use Beryllium: Professor Baxter, Chairman of the Australian Atomic Energy Commission, said recently that the Commission was now convinced that it could build a high temperature reactor using beryllium for the fuel canning. Australia has a plentiful supply of beryllium and it is hoped that another four to five years will bring forward a design for the reactor.

Piecing Together the Second Dreadnought: The electrical propulsion machines and control gear for the second British nuclear submarine are to be supplied by Laurence, Scott and Electromotors Limited.

Companies

Greater Capacity for Monotype Corporation

WHETHER it is adding new sizes to their type faces in Naskh, Cyrillic and Bengali, or providing a machine for the film setting of a newspaper in Urdu, the MONOTYPE CORPORATION is constantly engaged in developing its exports and introducing new equipment.

In a year when the demand for the Corporation's products has been heavy the necessity to add to the existing capacity has led to the decision to expand the manufacturing facilities. Accordingly, after consultation with Government departments and visits to the areas covered by the Distribution of Industry Act, Dunfermline in Scotland was chosen and construction of the new plant is now going on.

The three per cent increase in costs caused by the reduction of the working week to 42 hours was to some degree absorbed by technical improvements and by working to capacity. It is now extremely difficult to absorb any new wage increases by internal economies.

Brigadier Sir George Harvie-Watt, the Monotype chairman, explains in his annual report that there is no sign of relaxation in the pressure of rising costs brought on by the shorter working week.

Both at home and overseas, sales were substantially greater than in the previous year. In the United Kingdom while new users of Monotype equipment continue to come forward there are still very marked effects of the shortage of operators. Over the year there were 117 new Monotype customers from 37 countries (including Britain). Company sales have gone up by 40 per cent in the last two years at home and 45 per cent overseas.

The Corporation exhibits widely at trade fairs abroad, these have included Leipzig, Paris, Budapest, Barcelona, Poznan, Izmir and Brno.

There are now 20 countries in which the Monophoto Filmsetter is working commercially or is on definite order. In Teheran one such machine is to be used principally for a complete telephone directory in Persian—another is to film set a Pakistan newspaper in Urdu.

It is hardly possible to read, yet not to meet the works of the Monotype Corporation. Their activities in widening the scope of the typographical programme includes the completion of a full range of sizes in a new Clarendon type face.

A seven year survey of the Corporation's export sales shows that the turnover has increased by 130 per cent. In the same period home sales have risen by 70 per cent. From all 1960's sales, 69 per cent went overseas.

London to New York for only £47 10s?

An explosive expansion in the amount of freight carried by air has been promised since the closing years of the Second World War. When it eventually comes the recent application by an American airline, the only all-cargo operator on the North Atlantic, to fly passengers between London and New York at $133 (£47 10*s*) suggests that the effect on the level of passenger fares may be to force sharp reductions.

The United States firm is SEABOARD AND WESTERN AIRLINES. It has asked permission from the UNITED STATES CIVIL AERONAUTICS BOARD to carry fill-up loads of passengers from New York to the principal European centres.

Seaboard's plan proposes that no seat reservations would be made more than six hours before the scheduled time for departure. Intending passengers would then be handled on a first come first served basis. There would be a free baggage allowance of 66 lb but no meals would be served on the freighters.

At the moment, the cheapest one-way flight from London to New York is the £85 15*s* economy-class non-jet service. There is also the £114 6*s*, non-jet, 17-day round trip in which the passenger has to make the return within the stipulated period.

The aircraft which makes possible the economics of the all-cargo line's proposition is the Canadair CL 44, which Seaboard and Western will put into service in July. Equipped with ROLLS-ROYCE Tyne engines, the CL 44 will carry 65,000 lb of payload. Five have been ordered by the United States company. Their plan for the seating is to mount three abreast seats on pallets which may be installed in the aircraft a few minutes after the last of the cargo has been secured.

Among the procedural steps to be taken by the company (if it first wins approval from the Civil Aeronautics Board) is to obtain the permission of the INTERNATIONAL AIR TRANSPORT ASSOCIATION and of those Governments with national airlines currently operating on transatlantic routes.

Higher Turnover in the Kitchen

It may not be completely correct that when last year's credit restrictions depressed an already declining market for the big home appliances, like washing machines and refrigerators, the money went instead into smaller household goods. The PRESTIGE GROUP, however, whose products run from baking pans to carpet sweepers, while noting "somewhat difficult conditions" were able to increase their turnover—to £6,300,012, and before tax profits to £937,864 (against £881,164).

Sales both at home and abroad increased during the year but profit margins were generally lower. The principal causes were the rising costs of materials and labour. Export sales were at record levels and formed a higher percentage of the turnover than in 1959. Prestige has sales and warehousing companies in Belgium, Holland and Germany. Later in the year similar companies were added to the overseas organisation in France and Australia. A large proportion of foreign sales is in the territories of the European Common Market, particularly in Belgium and Western Germany. It is hoped that the same success will be achieved in France.

Last May, Prestige announced the purchase of the Ewbank carpet sweeper manufacturers, ENTWISTLE AND KENYON. The turnover and profits of this subsidiary both increased during the year and new products are planned for introduction this year. The aluminium foil container division of the Prestige group was sold early during the year to the IMPERIAL ALUMINIUM Company.

On the current year the Prestige annual statement reports that 1961 opened satisfactorily. The Ewbank sweepers, and the products of the O'CEDAR company, which was bought last year as part of the diversification programme, assist in broadening the scope of the group's sales. Further acquisitions are being looked for both at home and overseas. So far, a geographical table of the group's works and their products look like this:

Burnley: Cutlery, kitchen tools.
Derby: Stainless steel saucepans, pressure cookers, and kettles.
Slough: Mops, polishes.
Accrington: Carpet sweepers.
Blackburn: Step stools, household and commercial baking pans.

A three year summary of the financial history shows that group sales have climbed from just short of £5 million in 1958, to £5¼ million in £959 and to almost £6¾ million last year. Profit before taxation has moved in a similar direction, from £805,233 in 1958, to £881,164 in 1959 and then to last year's £937,864.

Road and Roof Surfacing Results

Working at slightly better prices in the later months of the past financial year, the public works and roads department of the road work and roofing firm WILLIAM BRIGGS AND SONS, of Dundee, carried out a greater amount of work during the year than in the previous twelve months.

The result of the prolonged wet weather of last summer was the further

tightening of the already close profit margins. The weather played an ironical part in the progress on the company's subcontracts on the Ross Spur Motorway (inset). It had not proved possible to take any very great advantage of the excellent weather of the 1959 summer and then last summer's conditions seemed as unfavourable as any in living memory.

Over the year, turnover improved and with the slight upward movement in prices the trading profit and investment income for 1960, after deduction of directors' remuneration was £328,558, against the previous year's £232,770.

A substantial part of Briggs activities are, of course, carried on in the North and among contracts carried out, or secured during the year, were asphalt surfacing and roadway reinstatement in Dundee, Aberdeen and Peterhead; runways at Kinross, RAF station; main drainage schemes at Arbroath and Monifieth; sea protection works at Stonehaven and road diversion work in Kincardine.

The work of the building contracts department was stepped up in the course of the year but most of the new business had been taken under intensely competitive conditions. The bad working conditions of the last three months of the summer raised working costs and produced less profitable completions. A "reasonable" export business has been maintained in bituminous building products (roofing felts, underslating felts, bitumen damp courses and so on) particularly in Middle and Far Eastern markets.

Export contracts for Briggs' BITUMETAL roofing, using aluminium or steel, include orders from Argentina, Iraq, Sweden, Sudan, Trinidad and Uganda.

United Kingdom customers for whom this work is being carried out, or has recently been completed, number among them the Steel Company of Wales, Richard Thomas and Baldwins, Colvilles, the United Kingdom Atomic Energy Authority, Cyril Lord and Tate and Lyle.

The two subsidiary quarrying firms had a busy year. They are the BURNSIDE QUARRY Company and CASTLEHILL SAND AND GRAVEL. Castlehill have opened and equipped a new sand and gravel deposit in Argyll near the new Loch Awe hydro-electric scheme, which it is hoped to supply with aggregate.

You Cannot Spend Yourself Rich

After extensive reorganisation of its manufacturing capacity and sales organisation the MASSEY-FERGUSON farm machinery concern has completed its first full year as a fully integrated international organisation.

1960 proved to be a difficult year in more countries than one for the agricultural engineering industry. Colonel W. E. Phillips, the Massey Ferguson chairman and chief executive officer, reports that though MF fared somewhat better than others, results as a whole were disappointing.

In the United Kingdom division, progress in reorganisation was more rapid than had been expected. The British section of MF is now in the charge of its own permanent executive staff. PERKINS, the Peterborough engine subsidiary, continues as a separate operation. Taking a broad look round at economic conditions, Colonel Phillips finds the Canadian economic picture disturbing and far from satisfactory. The situation is not confined to Canada. The MF chairman (the company has its headquarters in Toronto) detects "a slow but steady lessening of confidence in the soundness of our present day conditions."

Colonel Phillips sets out three "rather homely truths" which he believes may have some relation to present difficulties. They are:

The power to tax is the power to destroy.
You cannot drink yourself sober.
You cannot spend yourself rich.

First quarter results in North America show that sales were down 21 per cent, but this was largely to allow an adjustment of wholeseale inventories. This decrease is expected to be recovered in later quarters. Retail sales in the same quarter improved by 5 per cent.

Domestic and export sales from Perkins, UK, rose by 19·6 per cent over the same quarter of last year. From Massey-Ferguson in Britain there was an increase of 13 per cent. The company's UK exports were bouyant. Sales from the German unit rose 65·6 per cent over 1960's first quarter, in Australia the increase was 29·6 per cent.

Push-Button Integrated Cold Rolling

A new cold rolling steel mill requires operators who know how to push buttons, not lift large weights. The mill is integrated with an adjacent hot strip mill.

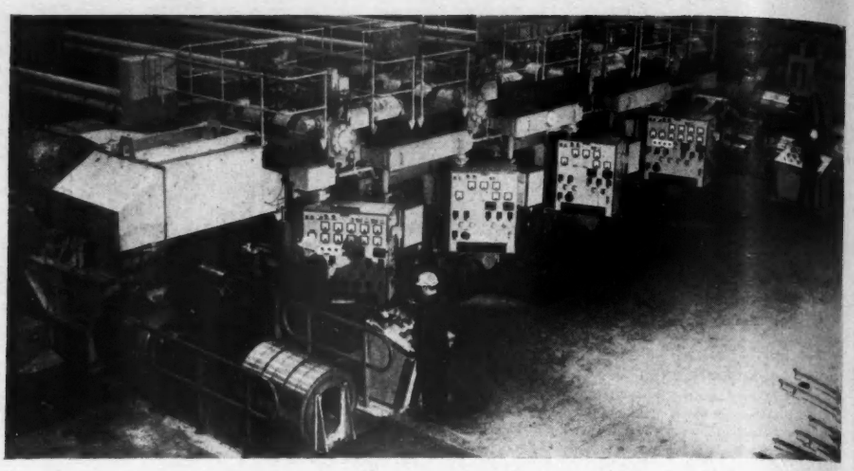


Fig. 1 The four-stand four-high tandem mill, with stand No. 1 on the right. Stands Nos. 1 and 4 are fitted with automatic gauge control.

EVEN if one does not go all the way with PEP in advocating a tax on the employment of labour, it is so obvious as to be almost a truism that a prerequisite of increased productivity is an increase in the proportion of capital invested to labour employed. In a country of dense population, limited natural resources and an appetite for high living standards, the principal source of national income must lie in industry's wit and skill in transforming cheap imported raw materials into valuable finished products. That is why it is heartening that Steel, Peech and Tozer, of Rotherham and the United Steel Companies Limited, have begun production in a £2 million highly automated cold rolling mill which has the great operational advantage of being integrated with their four years old hot strip mill.

In a sense, this introduction of partial automation in the cold rolling of steel is a result of the increasing use of automatic processes in the engineering industries. Faced with the economic necessity for automatic pressing, machining and transferring of materials in the manufacture of engineering products, it has become vitally necessary for cold rolled steel to be more consistent in size, composition and surface finish than ever before. Consistency of product, in fact, has been a primary consideration in introducing the new mill.

Under the old manual method of working, experienced operators mastered the art of cold rolling accurately but the fact that their skill was an art rather than a science made the end product unavoidably susceptible to variations in the humour of the operator. Automatic plant, on the other hand, does not suffer from bad moods, hangovers, sheer physical strain or periods of absence. Furthermore, mistakes can be noted and rectified immediately in an automatically controlled or governed process instead of being discovered after expensive damage has already been done, as can happen under manual methods.

At Steel, Peech and Tozer, strip for cold rolling is passed from the hot strip mill to the pickling plant and thence, in coil form, to the cold rolling department by way of an underground tunnel. Thus, transfer between the hot strip mill and the cold rolling mill is direct and effective, yet acidic fumes from the pickling department are excluded from the cold rolling mill.

When considering the type of primary mill to be used within the cold rolling department, the company needed to select a type adaptable enough to handle raw material varying from 18 in by 0·250 in, at the largest, down to 4 in by 0·048 in. It is a pity, perhaps, that it has not been possible to take a further leaf out of the engineering book by aiming at greater standardisation of product, but cold rolling mills have to meet a wide variety of customer specifications and it was decided that the primary mill should be of a compromise design able to meet variations in customer demand.

It was decided that the primary mill should be the four-stand, four-high tandem mill shown in Fig. 1. Under the old manual method of cold rolling, tandem mills did not usually operate economically on small sizes because of the difficulties met by operators in judging the roll gaps. This problem does not arise in this new mill, however, because, in effect, the automatic controls give the operator pre-knowledge of the roll gaps and he need only press the relevant buttons to keep production flowing smoothly and accurately. Automatic gauge control is provided on Nos. 1 and 4 stands on the tandem mill and there is automatic inter-stand tension control between Nos. 3 and 4 stands.

During the rolling operation the strip is not in contact with guides of any description, thus avoiding scratches or similar damage. It maintains its central position in the mill by means of the inter-stand tension. Any deviation in straightness of strip is indicated on panels attached to each stand, enabling the operator to make the necessary adjustments to ensure production of strip within very close limits.

The electrical plant in the mill embodies many of the latest developments and techniques in rolling mill control and, in fact, is probably the most *avant garde* part of the mill in that it has made the automatic control systems possible. Supervision of the complex electrical equipment is carried out from a central desk (Fig. 2) in the motor room into which are built the main controls and instruments. The attention of the maintenance personnel is drawn immediately to any fault occurring during rolling by both an audible and a flashing illuminated alarm, which automatically give the location and type of fault.

The mill motors, with a combined rating of some 4,300 hp, are supplied from rectifier/invertor units which serve the dual function of powering the mill motors during rolling and returning power to the supply during deceleration of the mill. Steel, Peech and Tozer believe this type of mill drive to be unique in this country. Another feature of the electrical equipment which is very advanced, and probably unique in this type of mill, is the use of static switching.

Rolls for the four-stand tandem mill are stripped and assembled in the roll shop and serviced by a mobile hydraulically operated table, ensuring a more precise set-up of bearings and chocks, and avoiding any shock treatment to the rolls. The rolls are ground on a roll grinder in all finishes up to a mirror finish, as shown in Fig. 3, and, after roll grinding, varying degrees of matt finishes can be applied by additional treatment in shot blasting equipment.

After rolling on the tandem mill, the strip is delivered to the annealing department which consists of two 290 ft long Nasshueur continuous annealing furnaces, each heated by five burners and each with a capacity of five tons per hour. The coils are fed to a tilting table (Fig. 4) which positions them on a tray, to be transferred to either of the two furnaces. From the charging of the strip to its exit after annealing, the process is completely automatic. The furnace section of the plant is heated by coke oven gas, and

Fig. 2 The fault finding panel in the motor room. Audible and visible alarms are installed.

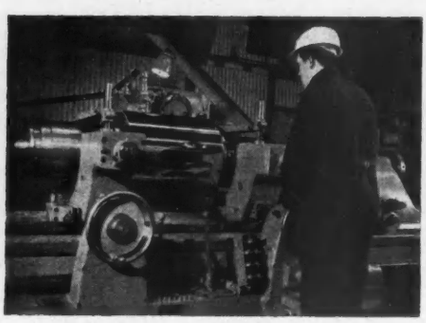


Fig. 3 Applying a mirror finish to a roll on the roll grinding machine.

Fig. 4 Coils of strip are placed on a tray on this tilting table preparatory to annealing.

nitrogen is used as a protective atmosphere throughout the heating and cooling zone to eliminate scaling or discoloration.

Coils of strip are only single stacked during annealing to obtain the greatest consistency of treatment, and one furnace has special settings for temperature, speeds, soaking times, and rates of cooling to enhance the ductility of deep drawing quality steels. As the coils emerge from the annealing furnaces, a bell rings automatically and loudly.

The coils of strip are then passed to a two-high temper mill where the feeding and discharge equipment are a duplication of those used on the tandem mill, and the strip is given a varying percentage of reduction to produce strip in the intermediate range from skin passed to three-quarters hard. At the same time that the physical properties of the strip are being improved during temper rolling, the strip surfaces can be varied from matt finish to mirror finish according to the surface finish of the rolls. In the temper mill, rolling is carried out to such fine limits—finer even than those on the last stand of the four stand tandem mill—that it must be unlubricated. The surface finish is very sensitive at this stage and, for example, would be spoiled if a cigarette ash were inadvertently flicked on to it.

From the temper mill, the strip is delivered to the slitting section where the strip takes on its selling identity—that is, its final size in relation to width, inside diameter and coil weight. The two slitting machines (one of them is in Fig. 5) are supplied by feeding equipment similar to that used on the tandem and temper mills, but on the recoiling head the strips are kept separate by an overarm separator and are stripped on to a receiving arm where they are finally strapped and labelled ready for despatch. To ensure accuracy on strip width, the slitting heads are assembled as a separate operation.

Fig. 5 One of the two slitting machines, on which the strip takes on its final size in width, inside diameter and coil weight.

Quality control throughout production is close and strict. While the automatic gauge control system ensures consistency of size, the metallurgy department carries out constant tests on hardness, ductility and surface finish before each stage of production. Their high degree of cooperation with the production personnel ensures that mistakes are difficult to make and almost impossible to perpetuate.

Steel, Peech and Tozer's new cold rolling mill is a very different animal from its predecessor, the manually operated mill—so different, in fact, that it has been deliberate company policy to employ green labour instead of using labour which would have to unlearn the old methods before learning the new ones. There is no doubt, though, that the green labour is now rapidly and enthusiastically losing its greenness, not only in operating the plant but in transferring strip between operations by gantry crane.

The new mill will be able to deal with all qualities of steel, but its principal part in the overall policy of the United Steel Companies Limited will be to cold roll low carbon steels in all tempers from hard bright unannealed to dead soft and intermediate tempers in the annealed condition. It is to be hoped that the 2,000 to 2,500 tons of steel which it will produce weekly will cut down those imports which tend to be contracted when home capacity is insufficient and have still to be honoured when the boom busts and home capacity is idle.

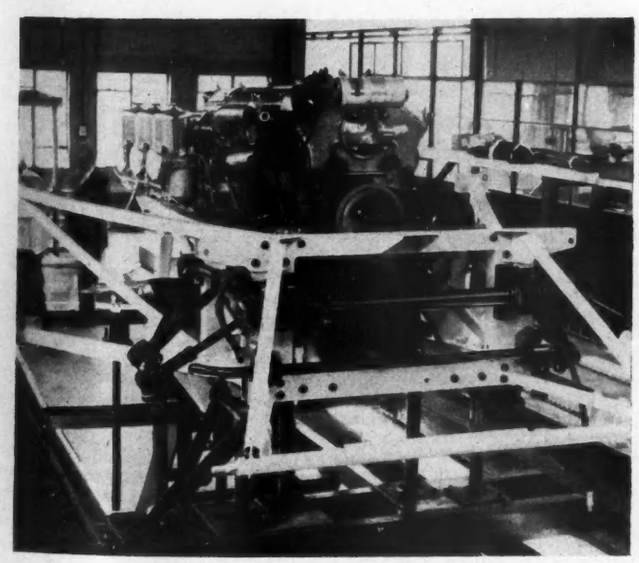
Producing the New Jaguar

By now, readers will be familiar with the details of the new Jaguar "E" type (if not, see ENGNG., 17 March '61, p. 393). They may not, however, be acquainted with the interesting way in which the car is produced. The efficiency of the production process is reflected in the remarkably low price at which Jaguar's are able to offer this high quality sports car.

The car is constructed basically from 20 gauge sheet metal and several techniques new to Jaguar have been incorporated in its production. The main panels are produced on a stretcher press—that is, by stretching the metal over formers—while the majority of the detail parts are produced either by the normal mechanical press or on a rubber die press.

The body is of monocoque all welded construction and several new techniques are incorporated in the welding processes, including the use of CO_2 wire welding equipment. The various details and panels are built up in jigs into main sub-assemblies, and then these various sub-assemblies are brought together in the main assembly jig. The completed body is then taken on a mechanical conveyor to the paint shop, joints in the body being metal finished and the whole of the external contour checked en route.

On arriving at the paint shop, the body shell together with its bonnet and sub-frame is taken through the phosphating plant in order to clean the metal thoroughly prior to the painting operations. It then passes through the under body dip to ensure that the whole of the underside of the car is protected against rusting.



In the assembly department, the front body section and the front and rear subframes are detached fram the main shell for separate sub-assembly work. Here, the engine and front suspension are put together as a unit.

This is followed by the application of two coats of primer, which, after baking, is followed by the application of sound deadening compound. The body is then mounted in a rotary transporter for its passsage through the paint shop where it is flatted and given a sealer coat followed by two final coats of synthetic enamel.

The method of assembly of the "E" type car is rather different from the other cars in the Jaguar range. On arrival at the assembly track, the front body section is removed from the main shell and transported on a separate conveyor along which various sub-assembly operations are carried out before it rejoins the car at the end of the assembly track. The front subframe is also detached from the body and this goes to the sub-assembly section where the engine and front suspension are put together as a unit. Similarly, the independent rear suspension assembly and differential unit is built up in its subframe as a separate assembly. At the same time, the electrical equipment, petrol tank, rear bumpers, rear lamps, and so on, are fitted to the main body shell. The two major sub-assemblies then meet the body at the beginning of the assembly track where the three are brought together on a high level staging. This facilitates the coupling up of the propellor shaft and other items which have to be fitted from underneath the car. The castor and camber of the front wheels are checked, after which the wheels are fitted and the car continues along the high level ramp for completion of all mechanical operations, such as fitting the pedal box assembly, the exhaust system and the air filter system. The car is then lowered on to the trim and finishing track where the various body details are added.

From the assembly tracks, the car is handed over to the test department whose drivers take it on the road and carry out a thorough test. Their report, together with the car, then passes to the rectification department where mechanics deal with any items requiring attention. The car is then retested by another driver and, if passed, handed on to the final line for further inspection of body and paintwork.

AC Generators for Transport Vehicles

The ac generator has certain advantages over the dc machine, particularly in applications where the engine operates at low speeds for long periods.

THE basic dc generating systems used in the transport vehicle industry have shown little change since the initial application of dc generators in the early part of the century. Performances have increased, detail design has given improved efficiency and increased reliability, but the basic electrical limitations of the dc machine have remained.

During this period the electrical loading of the vehicle generating system has steadily increased as a result of improved standards of comfort and vehicle safety. For example, a bus of the 1920's had a total electrical load of 150 watts as compared with 1,000 watts for its modern counterpart. In addition, the increased congestion of roads, especially in and around large cities, has impeded traffic flow to such an extent that the majority of the operating time of the vehicle may occur with the engine at idling speed.

Fig. 1 shows a typical curve illustrating distribution of engine speed in terms of total operating time for a typical public service vehicle in city service. It should be noted that 35 per cent of the time is spent with the engine at idling speed. This condition is obtained when the average route speed is in the 12 to 14 mph range. Any reduction in route average will increase further the time spent by the generator in the low speed range.

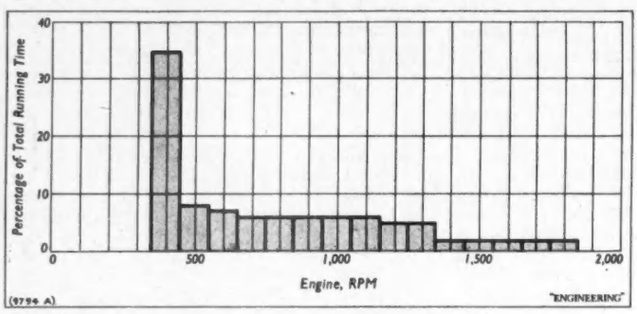


Fig. 1 Percentage of total running time spent in speed ranges, based on a typical public service vehicle in city service.

The combination of low speed and increased loading has led to the development of a system of generation which would ensure that the vehicle electric loading was met by the generator and in addition would enable the battery to be maintained in a satisfactory state of charge. Although this problem is mainly associated with road vehicles, an analogous condition occurs in the railways field in particular on diesel-engined railcars on relatively short routes, where comparatively long standing periods occur at intermediate and terminal stations.

Both road and rail applications were studied and since the majority of existing dc dynamos were operating at the limit of their speed and output range consistent with vehicle life, increased performance could only be obtained by increasing the size of the present dynamo range. This was unacceptable both because of the severe installation problems which would have arisen and the inevitable weight increase.

Details of ac generation were given recently in a paper, "The Application of Alternators for Transport Vehicles," by Dr. W. D. Sutherland, Chief Electrical Engineer of CAV Limited.

The solution is provided by the use of an alternating current generating system. In the conventional dc machine the actual power is generated as alternating current, but by the action of the commutator, this is rectified to direct current. In the alternator the power is generated in a similar manner, but the action of the rotating commutator and brushes is replaced by the static commutating device or rectifier. This gives the essential characteristic of the ac generator, which is its ability to provide an output over a speed range wider than its dc counterpart.

The pole pieces and field coils form the rotating assembly or rotor and only the field current is conducted to the rotor by brushes and slip rings. This current is usually some 1 to 2A, and since the slip ring forms a continuous contact with the brush there is no current change at the rubbing surfaces between brush and slip ring. This enables the field current to be conducted without arcing even at very high speeds.

The windings in which the current is produced are assembled in slots in the stationary yoke (the stator). This is the electrical equivalent of the rotating armature in the dc machine. With the stationary generating winding, the alternating current is brought directly to the terminals of the machine (see Fig. 2).

By using a three-phase winding arrangement instead of single phase an increase in output of 50 per cent can be obtained from the same frame size. A further increase in number of phases causes a slight increase in output, but in the machine outputs required for vehicle applications the extra winding and rectification complication is not justified.

The rectifier is an integral part of any alternator system and being a static item requires no attention when compared with the commutator it replaces. The alternator is wound for three-phase operation and hence to obtain the optimum value of dc current a three-phase full-wave unit comprising six or multiples of six rectifier cells is used. The basic connection of these with the alternator is shown in Fig. 3.

Semiconductor rectifiers are universally used for vehicle applications as their compact crystalline junctions are extremely strong mechanically and resistant to shock and vibration. Three materials, selenium, germanium and silicon, are employed, the choice depending on ambient temperature, cooling arrangements, space available and initial cost.

Applications

In the diesel railcar, the rectified ac charging system has been widely used in recent years and, since these cars are mainly used on suburban services and branch lines, frequent stopping and long periods of slow running are encountered. The introduction of the engine-driven alternator system in power cars has resulted in batteries being kept in a satisfactory state of charge. In these applications germanium rectifiers have been widely used but it is envisaged that silicon will eventually be applied in this field. Railways alternators with outputs from 50A in an 8 in frame size to 150A in a 14 in frame size are currently being produced by CAV.

In the motor vehicle field, the alternator has been successfully introduced in installations employing mobile radio where the extra load on the battery demands greater charging capacity. Invariably vehicles with radio equipment, such as fire engines, taxi cabs, police cars and ambulances, spend a large proportion of time at low speeds or "standing by" and hence require a generating system which gives output at engine idling.

For the public service vehicle field the broad case for output at idling has already been made, but this can be further illustrated by considering specific installations and the performance of the alternators which CAV have currently in pro-

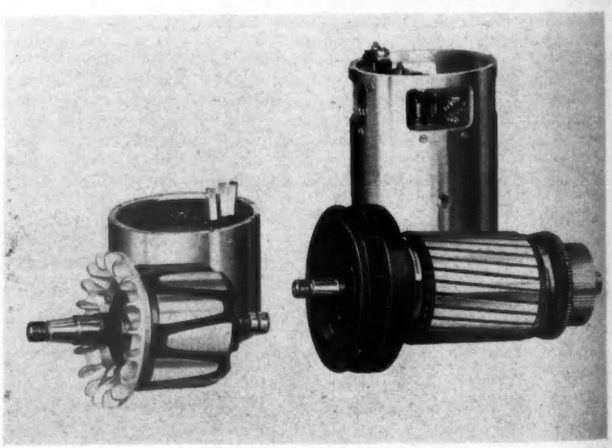


Fig. 2 Comparison of ac generator (left) and dc generator (right).

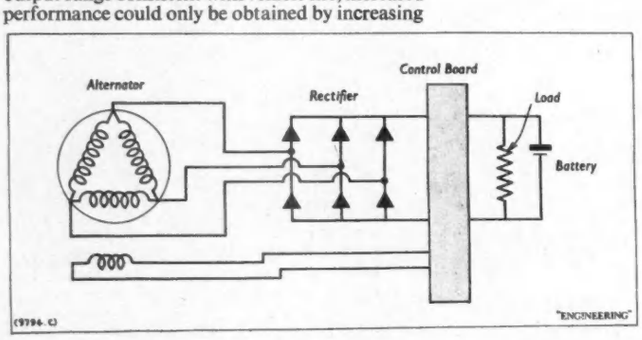


Fig. 3 Simplified wiring diagram of ac equipment.

duction. [Some will be on show at the forthcoming Engineering Exhibition at Olympia.]

The present standard public service vehicle dc generator is 7 in diameter with an output of 55A at 24V and this can be driven at ratios of up to 2·3 to 1. When this machine is replaced by the 7 in alternator, the increase in output at idling is such that a large percentage of the vehicle electrical load is now supplied by the alternator at idling conditions.

This machine is designed for 24V systems and has a self-limiting output of 60A at 27·5V. The cutting-in speed of the generator is 580 rpm. With a drive ratio of 2·3 to 1, the generator output at normal idling speeds of 350 to 400 rpm will be from 19 to 29·5 amps. If the drive ratio is increased to 2·5 to 1 the output at the same speeds will be from 25 to 35 amps.

At present, the CAV 7 in alternator is available with a selenium rectifier as a separate unit and hence the basic weight comparison is:

1. 7 in dc generator	84 lb
2. (*a*) 7 in ac generator	37½ lb
(*b*) Selenium rectifier ..	20 lb
Total ac system	57½ lb
Saving in weight	26½ lb

The application of silicon diodes within the machine is the next logical step and many prototype machines are currently in service.

The weight comparison is now:

1. 7 in dc generator	84 lb
2. 7 in ac generator with built-in diodes	38 lb
Saving in weight	46 lb

Two alternative types of control board are available to match this generating set, one fitted with a conventional vibrating contact type regulator and the other employing a transistorised regulator.

The alternator system comprises a 7 in machine, a selenium rectifier and a regulator, either transistorised or vibrating contact, and with this system the advantages over the original dc installation may be summarised as:

1. More output at low speeds.
2. Less weight of installation.
3. Less servicing as commutator is removed.
4. Possibility of reduction in battery capacity.

The application of ac systems to public service vehicles is in its infancy but it is certain that because of its many-sided advantages this will rapidly extend until finally all vehicle generation will be of this type.

CAV Limited, Acton, London, W3.

Remote Observation and Control of Traffic

For a policeman on point duty, the early recognition of traffic approaching from different directions is necessary. The same duty is being performed at certain busy intersections by closed circuit television equipment of the type already found in industry.

One example of this is in West Germany, at the Platz der Republik in Frankfurt am Main. Traffic regularly became congested during the rush hours and could not be sorted out with sufficient speed by the policeman on point duty. A closed circuit television system was given a trial, and it worked so effectively that the local authorities kept it there.

Made up of two television circuits between the Platz der Republik and the traffic control centre at the nearby police headquarters, the traffic is closely observed by two cameras which display information on separate screens (left). One camera is fixed and furnishes an overall picture of the rotary traffic, while the second is swivel mounted on a mast (right) in the centre of the intersection and can be panned and tilted by remote control from the control centre. This camera is used to study sections of the rotary traffic or to observe approaching traffic.

The arrangement gives continuous observation of the rapidly changing traffic situation at the intersection and at the same time gives flexible control through the advance observation.

Siemens and Halske, AG, Hofmannstrasse 51, Munich 25, W. Germany.

Counting Traffic Automatically

One of the more important factors considered in traffic studies is the flow of vehicles, normally measured in terms of vehicles per hour. Although manual methods are adequate for short jobs and provide the only reliable method of classification, it is more satisfactory to use automatic counters when carrying out long-term counts to establish monthly or yearly trends.

Some points about automatic traffic counting were contained in a paper entitled "Instrumentation for Traffic Studies", by J. A. Hillier, presented before the Traffic Engineering Study Group of the Institution of Civil Engineers recently and are given here.

Traffic counters consist of two main parts, the detector, which senses the passage of vehicles, and the counter which records the number of pulses transmitted by the detector.

Detectors

Although several designs of detector are available, the most common is the pneumatic detector consisting of tyre-quality rubber tube approximately ½ in od by ¼ in id. This is stretched across the road so that the tube lies closely in contact with the road surface and the passage of vehicle wheels over the detector causes an impulse to be transmitted through the air in the tube to a light diaphragm switch in the counter.

It is important to place the detector at right angles to the passage of the vehicle so that each axle records as one unit. It is also important that detectors should be correctly terminated to prevent unwanted reflections from the far end, causing extra counts when a heavy vehicle passes. A termination plug has been developed which effectively cancels out these reflections.

The use of rubber-tube detectors on motorways gives rise to problems particularly with regard to the safety of the staff maintaining the installation. As a result, special detector fastenings have been developed for use on the M1. They are designed to be installed permanently in the road surface and to carry the detector tube freely, so that a fresh tube can be connected to the old one and pulled through.

Traffic Counters

Two forms of traffic counters are commonly used: a simple accumulating counter and a more complex recording counter.

The first type consists of a light diaphragm switch, an electromagnetic counter unit and two 6V dry batteries. In the diaphragm unit, the energy contained in the air pulse is used to push a light beryllium copper diaphragm and causes the momentary closure of two contacts normally spaced about 0·01 in apart. The sensitivity of the diaphragm unit can be adjusted by varying the size of this contact gap.

The life of the counter unit is largely determined by the small cyclometer type counter which is not really designed to work as fast as required in this instrument. The average life between counter failures has been found to be about 750,000 nominal vehicles which is very close to the average life of the cyclometer unit itself, although some cyclometer units last much longer.

The recording traffic counter most frequently used in this country is of American origin made by the Streeter-Amet Company of Illinois, but it is likely that similar counters will be available in England in the near future.

This instrument is much more complex and costly than the simple accumulating counter, since in addition to a diaphragm unit of similar design to that used in the simpler instrument, there is also provision for printing the recorded counts every hour on a strip of paper together with the time at which the counts were completed. The counter resets itself each time it prints.

Power is supplied by a 6V accumulator contained in the base of the instrument and the spring driven power clock used to release the printing mechanism is readily accessible at one side of the counter.

These counters require more elaborate maintenance facilities than the non-recording counters and cost approximately six times as much. The supply of paper tape is sufficient to last several months and the accumulator will last for at least two weeks if fully charged. The power clock will last for at least eight days, but owing to the changes in temperature which can be experienced it is desirable to visit each counter at least twice a week if possible to check with an electronic clock-timing device.

On the Shelf

By Frank H. Smith

A couple of lads who came into my library were quite nonplussed the other day when I told them that jeans, sloppy Joe sweaters and coffee-bar-cowboy half boots were not the sort of wear in which to visit a learned society. I wore the famed Smith half-smile to take some of the venom from my voice, because I realised that their mentors probably do not care two hoots how they dress at the College of Advanced Technology, but before the commissions start thinking in terms of classics for technicians they might think about teaching some of the intelligentsia some manners.

I do not think I have ever seen a national prestige propaganda magazine put out by British publicists, but however good they may be they will be hard put to it to beat the Czechoslovak *For You*, number one of which has just reached me. This extols the beauties and virtues of the country's products such as glass, ceramics and violins while, at the same time, emphasising its health and national vigour and general culture. *For You* is not, unfortunately, a giveaway (it is obviously too expensive a production to permit this) but subscriptions can be made through Collets Holdings Limited (44-5 Museum Street, London, WC1) at an equivalent of $6.

A quaintly-titled body called Sodexport, of 7 rue Servandoni, Paris 6e, me prie d'apporter la plus grande attention to a Revue that they ont le plaisir de m'adresser called *Realités scientifiques et techniques francaises*. This seems to be a list of books published on various subjects into which they are divided and each title has a translation of the title into English and Spanish which, as they point out, makes it facile a consulter grâce a son classement systématique et à ses rubriques en trois langues: Francais, Anglais, Espagnol. Have no fear—On the Shelf is in no danger of becoming Sur le Rayon. Comment vous procure *Realités scientifiques et techniques francaises*? Par L'intermédiaire de votre libraire habituel ou, à défaut, en retournant à Sodexport, etc., etc., le Bulletin de souscription ci-joint. Until I read that last bit I thought it was buckshee but I see it costs 8 NF so perhaps we'll forget the whole thing?

No bibliothèque should be without the *Catalogue collectif des livres francais de sciences et techniques 1950-60*, which can be obtenu du Syndicat National des Editeurs, 117 Bd. Saint-Germain, Paris 6e. Extraordinary set-up. It looks as though about cinquante of these editeurs have got ensemble and publiés the lot. It is a bit tied up with Sodexport.

If Russian or Japanese patents have any significance in your life, get in touch with Derwent Information Service, Rochdale House, Theobalds Road, London, WC1, and you had better mention that your inquiry was inspired by reading about it in Engineering. How else will people be persuaded to tell us their life histories so that we can pass them on to you?

A title such as "Recent Research on Fatigue in Metals" is a cinch for a list of references; the March, 1961, *Chartered Mechanical Engineer* is true to type with 67 of them. While you are glancing at it, turn the page to "Windmills—Their Rise and Decline" and shed a tear for the passing of the picturesque.

I wonder if it is a criterion of the impatience of editorial departments when they issue "Notes for Authors"? Be that as it may, a neat little booklet with that title comes from the Iron and Steel Institute, 4 Grosvenor Gardens, London, SW1.

From a firm of publishers I have been offered the following at 8*s* 6*d* a time: *Distant Love*, *The Devouring Flame*, *Love's Conflict*, *Love on Trial* and *Poisoned Love*, and if anybody wants the name of the publisher I will send it in a sealed plain envelope on receipt of suitable hush-money.

Spectrum of Road and Traffic Economy

Highway Engineering Handbook. Edited by Kenneth B. Woods. *McGraw-Hill, New York and London.* (194*s*)

Highway Engineering. By Leo J. Ritter, Jr., and Radnor J. Paquette. 2nd Edition. *The Ronald Press Company, 15 East 26th Street, New York 10.* ($10)

In highway engineering, as in other branches of engineering, the key to successful planning and design is an exact knowledge of the loading conditions on which plans should be based. The unit of loading, in this case in the motor vehicle and traffic engineering techniques, provide, the means whereby comprehensive assessments can be made of the magnitudes of access, circulation and parking problems concerned with any highway plan.

In urban areas, traffic problems are particularly complex and the ever increasing degree of congestion highlights the work of the highway and traffic engineer in that field. The high cost of roadworks in urban areas and the economic consequences of any engineering operations require that priority should be given to those schemes which would yield the highest rates of economic return. In this respect, the values of the ratio, road user benefit to construction cost, would indicate the relative importance of various projects.

With the knowledge of the basic facts relating to land use and origin-destination patterns, the engineer can determine the routes for new highways for optimum service and economic return. This phase of planning can be considerably accelerated by the use of electronic digital computers. The impact of automation on traffic assignment procedures is one of the most significant advances in modern highway planning.

Knowing the route location for optimum economic return and the consequent magnitudes of the potential traffic volumes, it is then possible to proceed with the detailed geometric design of the carriageways and intersections. The chief factor in geometric design is the speed of traffic operation. It controls the radii of curves, gradients and sight distance, location of signs, carriageway markings and signals. With roads of the motorway type, the design speed controls the length of acceleration and deceleration lanes and the geometric form of interchanges.

Aesthetic factors have to be considered at the design stage. Landscape treatment, structural form and highway lighting are typical examples.

The construction of flexible or rigid pavements for carriageways nowadays frequently involves the use of either stabilised soil or lean concrete bases. Advances in this field have been quite considerable in recent years. Finally, the surface finish of the carriageway material has to be carefully considered in relation to its resistance to skidding.

Each of the above items forms a component of the "spectrum" of highway engineering, so called by Professor K. B. Woods of Purdue University in his editorial preface to the impressive *Highway Engineering Handbook*. A total of 48 authors were involved in the production of this book, each being an eminent specialist in the subject on which he has written.

The 1,696 pages of text are grouped into four parts. Part 1 deals with administration, economics, planning and traffic engineering. To Europeans, the section on urban transportation planning by Mickle and Voorhees, and that on traffic engineering by Berry will be of special value. Part 2 examines the properties of engineering soils and the application of the principles of soil mechanics in the design and construction of earthworks. Part 3 covers contracts, specifications, and the physical properties of aggregates used in concrete and bituminous mixes. Part 4 includes sections on geometric design, flexible and rigid pavements, and landscaping.

Although the statistical data quoted in the *Highway Engineering Handbook* applies specifically to the United States, the basic principles of engineering economics, traffic engineering and highway engineering which are applied are of universal interest. In particular, I would stress the value of the chapters which deal with the following subjects: priority ratings for highway improvements; benefit cost indices for economic returns; origin and destination traffic surveys; traffic assignment on competing facilities; parking surveys; the use of digital computers in traffic analysis and surveying; accident analysis; speed-volume-capacity studies; one-way traffic systems; signs, signals and carriageway markings; channelisation; stability of soil in cutting and embankment; hydraulics of drainage systems; flexible and rigid pavements; and skidding resistance of road surfaces.

This handbook is without doubt the most comprehensive and up-to-date book on the practice of highway engineering in the United States. Although its high price places it outside the range of students' textbooks, it should be a standard work of reference in the design offices of consulting highway and traffic engineers, county highway authorities and city engineers' departments.

The second edition of Ritter and Paquette's book on highway engineering is an enlarged version of the well-known 1951 edition. The text has been revised to include details of recent developments in the United States in the field of highway engineering. In particular, major revisions were made in the section dealing with highway economics and finance, and also the chapter on the hydraulic design of culverts. Of the 721 pages of text, a total of 373 pages is devoted to pavement design, construction and maintenance. The chapters on flexible pavements are particularly comprehensive and well written. For European engineers this will probably be the most valuable section of the book. Its price places it within the reach of students, and it would be a worthwhile addition to any reference library.

T. E. H. Williams

Motorways Designed to Live With

The Landscape of Roads. By Sylvia Crowe. *Architectural Press.* (18*s* 6*d*)

Anyone who has heard Sylvia Crowe lecture or has read her books knows that her approach to landscape architecture is thoroughly professional, and that she understands the engineer's difficulties in the siting and construction of modern highways. This fascinating book, lavishly illustrated with photographs and drawings, treats a topic which has had insufficient attention. Engineers in charge of highway construction can learn much from the eight chapters if they can abandon their prejudices and realise that what may look like a subsidiary matter is of vital importance.

The first two chapters on history and policy can scarcely be considered to be within the subject of the book, but are useful as a background. The chapter on policy is one which is likely to be glanced through without close attention by those engineers who already know all the arguments about motorways, accidents, and pedestrian separation.

Miss Crowe invents her own road classification which, although it confuses the issue somewhat, is much simpler and clearer than the cumbersome Ministry "trunk," "classified," etc., which terms often refer not to the type of road, but to how they are financed! Miss Crowe correctly argues that a clearer demarcation is necessary, but, occasionally, herself strays from her own classification and uses "through-road" and

"traffic-way" which she does not define with the other terms.

When she moves into the civil engineering field, Miss Crowe shows a few weaknesses. The bypassing of towns, for example, may not be "one of the greatest contributions . . . to humane and livable quality." Much depends on the size of the town, and, in fact, the word "bypass" is one which might well be abandoned, with benefit to clear thinking about highways. Miss Crowe should note that the major professional engineering body is an "Institution" and not an "Institute." Slopes of banks depend on the mechanical stability of the soil and cannot always be altered to suit the landscape, however eager the engineer may be to produce good visual effects.

Chapters 3 to 8 are of great value, and deal with character, road structures, parking, planting and the road team. All the arguments of these chapters require to be stated, and the gathering together of facts, sketches and photographs about visual effects of engineering construction is certainly valuable and welcome. Miss Crowe has an incisive judgment, and all through these chapters are statements which should be noted by those in authority. For example, the "uncritical precedence" given to roads with the concurrent neglect of the architectural and planning facets of development has been troubling many thinking professionals, and Miss Crowe's criticisms in this direction are timely.

In dealing with central reservations on dual-track highways, Miss Crowe makes too much of the problem of central planting. She herself mentions the possibility that glare may be eliminated by the better design of headlights. Indeed, this improvement is being made in this country, and the need for central planting will not be long in disappearing. The widening of the central reservation of which Miss Crowe approves will almost certainly appear in future motorways in this country probably in the form of a wide, V-shaped ditch with side slopes of about 1 in 4. This is necessary for protection against the most frequent cause of fatal accidents on the Continent and in the United States—a car out of control, crossing the central reservation.

Whether such a widened central reservation will achieve Miss Crowe's aim of improved appearance is doubtful, and parallelism may well have to be accentuated for the sake of safety. Even a small slope separating carriageways can be a source of danger and the varying levels of carriageways, which admittedly give better landscape design, cannot always be looked upon as entirely desirable unless the horizontal separation is substantial, or an effective barrier is erected between the two tracks.

Chapter 4, which deals with Roads in the Landscape, is of particular value to engineers, bringing together as it does powerful arguments for the cooperation of engineers and landscape architects. The relationship of the road to the landscape in different types of country is a valuable part of this chapter. Miss Crowe is quite right in objecting to fast traffic in residential areas, and this fault can be put right by the construction of urban motorways which, in cities, drain off the traffic which would otherwise follow a labyrinth of residential streets.

The emphasis at many points in these well-written chapters on the necessity of the road being to a "human scale" appears to be somewhat illogical. Indeed, Miss Crowe herself agrees with the complete insulation of motorways from the surrounding communities and speaks of this as "perhaps the logical solution for a means of through-traffic unrelated to human life." It would seem just as logical to provide inhuman-scale roads for the inhuman motor car as to provide great docks for the equally inhuman-scale Queen Mary.

How these modern highways should be married to the landscape is treated fully and in detail, with many comparative photographs and drawings. One turns, for example, with interest to the pages dealing with M1, and finds Miss Crowe in a mood for battle. It is a great pity that book production is so slow that M1 was still under construction when this book was written. The ditches, the hard slope of the banks, the harsh line where bank joins landscape, and the bridges on M1 all receive reasoned criticism. Miss Crowe is also critical of the "grudging concession" given to the consideration of any "interests other than those of traffic engineering." She pleads for a road team to include a landscape architect, and has certainly proved her case in this book. One is a little nervous, however, that other landscape architects may well fail to have this author's penetrating insight and fall back on what Miss Crowe calls scathingly "cosmetic treatment"—an over-emphasis on planting, with insufficient attention to form.

Very little adverse criticism can be levelled at this attractive work. Miss Crowe's use, here and there, of single-sentence paragraphs shows an unfortunate tendency to follow the unenlightened technical writers whose work nowadays abounds in this regrettable habit. The curious and rather self-conscious chapter headings, four: roads in the landscape, five: road structures, six: parking and picnicking—makes one think of a partridge in a pear tree.

W. FISHER CASSIE

Chancellor's Chicanery on the Great Tax Dodge

Inflation and Society. By GRAHAM HUTTON. *Allen and Unwin.* (15*s*)

A married man with one child, who had a gross income of £500 a year in 1938, would, allowing for increases in income tax and for the fall in the buying power of the pound, need no less than £1,700 today to recapture his 1938 standard of living. This is one result of inflation. In a simply written but important and timely book, which every voter (and, indeed, every housewife) should digest, and then send by registered post to their member of parliament and borough councillor, Mr. Graham Hutton explains how inflation arises and the evils that it causes.

Most inflation, in most countries, has occurred since the war because so many governments have launched out on capital development programmes and social security benefits, while shrinking from warning that if new houses, schools, hospitals, and factories are built without previous saving, and are simultaneously accompanied by higher wages and salaries for current consumption, inflation is inevitable. The longer that it lasts, the slower the rate of increase in wealth, and the faster the spread of social discontent. Inflation reduces efficiency and distorts and weakens the economy. Rather than face the short-term unpleasantness that must follow a halt to inflation, governments usually prefer controls, permits, and priorities. These attack symptoms, not causes, and make confusion worse.

Inflation is always a deliberate act of policy, whether positively willed by the finance minister or weakly allowed because he fears to stop it. The average business man is humanly limited in the range of his knowledge when making decisions, but where a market is allowed freely to establish values, prices are reliable guides because they are settled by innumerable economic realities of which he personally may know nothing. The rate of inflation creates different attitudes in borrowers and savers towards the worthwhileness of spending or saving. The faster the inflation, the more reluctant will people be to tie up savings at fixed rates of interest. As wages and all other costs rise, firms and governments will need more and more money, both to pay for fixed long-term assets like building, and for day to day working to meet ever rising current costs.

The arguments against inflation as a policy are, first, that it arbitrarily upsets all demand and supply, and prevents prices from performing their function, which is to allocate resources in relation (*a*) to their comparative scarcity and (*b*) the strength of the competing demands for them—in other words to tell everyone concerned what the real value of all goods and services are.

Second, inflation arbitrarily alters all legal and other social relationships built up on the assumption that real values are known. One of Mr. Hutton's most important contributions to current debate is to point out that if it were possible to foretell just what effects a given dose of inflation would produce, these two arguments against inflation could be ignored.

Apologists for "just a little inflation" could urge that a steady dose would be absorbed into the daily data on which citizens base their decisions, would be discounted in all their calculations, would be assumed as is the level of income tax or turnover tax or company's profits tax, and would therefore do no harm.

But that is to misunderstand the object of inflation as a policy. Because as soon as everyone assumes a given rate of inflation (2 or 3 per cent a year is suggested by many apologists) and discounts in advance its effect on all their calculations, the finance minister—who benefits by giving himself the extra money to buy the goods and services which he wants at higher prices which prevent the rest of the population from being able to afford them—must step up his rate to secure the prior benefits of fresh inflation above what all the citizens have discounted. If he does not do this, he cannot prevent individuals and firms from securing the services, bricks, plant, or machinery, that he needs to carry out his electoral promises.

To ensure inflationary advantages over everyone else, as a set policy, the finance minister can never say thus far and no farther: he must inflate more and more. This cumulative inflation leads governments to multiply controls on individuals, trade, industry, and institutions, often to raise income tax, and to impose or increase purchase taxes.

Thus a state which, as a policy, secures inflationary benefits for itself ultimately abolishes individual freedom. This was the fate which overtook the Roman Empire in the third century AD and Germany after the First World War. This is the path along which France had been inching her way until de Gaulle's reforms, the path on which Mr. Heathcoat-Amory courageously called a halt.

It remains to be seen to what extent his successor will feel strong enough to ignore the outcry against some of the short-term results, such as the "outrageous" rise in the values of building sites and the "profiteering" of landlords at last allowed to charge rents which reflect the true relation between the demand and supply of living or office space.

Mr. Hutton observes that ten years ago the ordinary weekly wage earner could not have dreamt that he would ever be liable to surtax, which begins—as forty years ago—at £2,000 a year. But today a number of weekly wage earners pay it. And he adds wryly, by 1969, if inflation continues as in 1949 to 1959, one third of all the United Kingdom's weekly wage earners will be surtax payers!

In all countries with progressive taxation, inflation (1) increasingly penalises those in positions of responsibility in government, industry, commerce, and public life; (2) relatively benefits—and therefore stirs up demands for increased wages and salaries from—the best organised groups, and therefore also provokes more and more groups to organise themselves; (3) gives advantages to the lower income-earners, whose money incomes can rise farthest before attaining progressive taxation brackets, where heavy taxes become payable; and (4) increasingly

punishes all claimants to fixed money incomes in the future.

That society flourishes which promotes the interests in common of its citizens. Inflation disintegrates by adding to the inevitable stresses between groups and by creating new resentments. It makes most businesses highly profitable in paper money; they can pay their taxes, their rising costs, and good dividends. Other businesses, especially exporters, who have to compete with foreign prices, may be badly hit; so at the same time may their workers and shareholders.

The interests of the old and retired are set in opposition to those of the young or middle aged; those of the unproductive against those of the productive; those of the prudent, who saved at long-term fixed interest for the future, against those who, realising what is happening, become quick in-and-out operators who make their profit by not holding on to any money. The interests of all who save, contribute, build, and create for a long-term future are set against those dependent for profit on the highest velocity of circulation of money. Inflation causes arbitrary, windfall distribution of inflationary profits, unrelated to efficiency or productivity.

With a stable currency, those firms make money which are efficient in meeting demand; the inefficient lose money and are squeezed out. Resources are thus reallocated more profitably and the national income grows.

JOSSLEYN HENNESSY

Mark of Cain

The S Man: A Grammar of Success. By MARK CAINE. *Hutchinson.* (12*s* 6*d*)

There are many kinds of success. The sense of achievement in solving a complex problem or in securing professional recognition are examples that come readily to mind. But success in the sense of being top dog is related to the lust for power. "Getting on" in its more unsavoury forms; manoeuvring gradually in the upward direction, using other people on the way, however much it may injure them, are merely aspects of power seeking.

To travel ruthlessly in order to arrive makes for a colourless journey, and even at the end, the fruits of success may prove less sweet than was ancitipated, though to hold sway may seem very sweet in prospect. But the fevered single mindedness, the blind indifference to the hopes and fears of other people are, rather, symptoms of a sickness, a sickness for which there is no cure, since in its course the personality inevitably wastes away, like sight, imprisoned in a darkened room.

Or does it all seem different to the power seekers? Are they in fact thrilled by the chase, stimulated by mortal combat, and rewarded in the end by the pleasures of command? Who knows?

Publishers' preambles do not often strike a really true note but here is an exception. Says the working on the inside flap: "Machiavelli addressed the Prince. Mark Caine addresses the common man." In the times of the Renaissance the use of power was the perquisite of aristocracy. In the later nineteenth and early twentieth century it was reserved for the plutocracy.

In this age it is a tenable point of view that power over others and any other kind of success should be within the reach of every man. It should be expected to go with subsidised dentures and full employment. Nothing is too good or too desirable to be distributed. The argument thus comes full circle and the common man has the right to struggle to be uncommon.

Let us all accept the Kantian principle and universalise the urge to success. (Kant was concerned with ethics but he was very old-fashioned.) Let every one of us accept the challenge of our times and take the opportunity to be successful, even if to do so we must exploit all the others. Let us all employ the rules of gamesmanship and may the strongest man win.

Such are the conclusions to which entire preoccupation with material values can lead. If you really believe that we have never had it so good and want to have it even better, you can, if your bent lies that way, write as readable, as funny and as ugly a book as this one. There are two ways you can write about gamesmanship as applied to uninhibited ambition. You can either put your tongue firmly in your cheek or you can protest that you mean every word you write. Mr. Caine says he means it and the autobiographical notes on the dust jacket suggest that he has at least tried it out.

Well on in the book the author says ". . . neither goodness nor beauty is a term relevant to S-analysis. . . . The success is a master of duplicity." This standard is accepted from the beginning and the author continues inexorably from there. Failure, adolsecence, building up a business, social success, sex and marriage are handled wittily, shrewdly and devastatingly from this point of view. The style is astringent and the phrases delightfully turned. As he well knows, the author makes the reader remember every dirty trick (petty or grand in scale) which he has ever committed and gained from. One is told to press on nimbly. As Mr. Caine might say, it is the size of the dividend that matters if you buy a share in a glue business, not the smell from the factory.

In this world, the man of mere professional or intellectual standards is a very poor fish. You are invited to abandon the hallmark of quality for the mark of Cain. But before accepting the invitation, have some entertaining reading with this book—interlaced at every fifty pages with a verse from Kipling's "If." You may prefer you as you are.

G. E. TEWSON

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Plant

Chain Conveyor. THOMAS ROBINSON AND SON LTD., Rochdale. "Linkalong" chain conveyor for powdered and granular materials. Capacities up to 3,900 bushels (5,000 cu. ft). Leaflet ill.

Tub Puller. RICHARD SUTCLIFFE LTD., Horbury, Wakefield, Yorks. Hydraulically operated tub puller; sizes with pulls up to 13,500 lb. Leaflet, ill.

Barrell Plating. FREDERIC B. STEVENS INC., 1800 Eighteenth Street, Detroit, Michigan, USA. Automatic rack and barrell plating machines. Continuous or batch production. Various brochures, ill.

Metal Baskets. TOOL TREATMENTS (CHEMICALS) LTD., Colliery Road, Birmingham Road, West Bromwich. Round and oblong baskets in steels with or without plastic coating. Most sizes. 16 pp., ill.

High Temperature Furnaces. GENERAL ELECTRIC CO. LTD., Erith, Kent. High temperature furnaces with hydrogen atmospheres for operation up to 2,500° C. Batch and continuous types. 4 pp., ill.

Electrostatic Precipitation. HEAD, WRIGHTSON AND CO. LTD., 20 Buckingham Gate, London, SW1. Electrostatic precipitation compared with other methods and applied to iron and steel industry. Design and installation. 16 pp., ill.

Cyclone Dust Collector. STURTEVANT ENGINEERING CO. LTD., Southern House, Cannon Street, London, EC4. High efficiency cyclone dust collectors range down to 15 microns. Folder, 6 pp., ill.

Mining Equipment. WESTINGHOUSE BRAKE AND SIGNAL CO. LTD., 82 York Way, King's Cross, London, W1. New additions for the catalogue; CP7 control of mine vehicles; CP8 auxiliary valves; CP26 combined stop and restarter; CP27 traffic control; CP29 propelling unit (for cars); and CP1010, traffic control at the Hawthorn mine. All ill.

New Books

Applied Building Construction: A Third Year Course. By ANTHONY MEDLYCOTT. *Chapman and Hall.* (25*s*)

Following the format of the previous volumes, this is a clearly laid out and fully illustrated manual on building techniques both for practising architects, builders and surveyors, and for the student.

Principles of Stellar Dynamics. By S. CHANDRASEKHAR. *Dover Publications, New York; Constable, London.* (16*s*)

This is the 1942 edition reprinted together with additional material previously published in *The Astrophysical Journal* and *Annals of the New York Academy of Sciences.*

Radio Waves in the Ionosphere. By K. G. BUDDEN. *Cambridge University Press.* (95*s*)

The object of this book, which is based on a course of lectures given annually in Cambridge since 1956, is to set out the mathematical basis of the theory of the propagation of radio waves in a horizontally stratified ionosphere.

Silicones. Edited by S. FORDHAM. *George Newnes* (36*s*)

Drawing extensively on their experience in the Silicones and Research Departments of the Nobel Division of ICI, the authors have put together a picture of the present state of knowledge of silicone technology, from chemistry through manufacture to applications, including treatment of textiles, leather and masonry, incorporation in polishes, and electrical properties.

Polypropylene. By THEODORE O. J. KRESSER. Reinhold Plastics Applications Series. *Reinhold, New York: Chapman and Hall, London.* (52*s*)

The latest volume in this series of guides to plastics covers the properties, chemistry, production, processing and applications of polypropylene, a material which shares many of the good properties of linear polythene, but which eliminates some of the more serious faults.

The Reviewers

Dr. T. E. H. Williams, A.M.I.C.E., A.M.I.Struct.E., is Rees Jeffreys Reader in Highway and Traffic Engineering at the University of Durham and head of the traffic engineering division in the Department of Civil Engineering, King's College, Newcastle upon Tyne. He is also convenor of the Symposium on Urban Survival and Traffic to be held at King's College from 10 to 14 April.

Professor W. Fisher Cassie, Ph.D., M.Sc., Dip.T.P., F.R.S.E., M.I.C.E., M.I.Struct.E., M.Inst.M.E., occupies the Chair of Civil Engineering at the University of Durham (King's College).

Mr. Jossleyn Hennessy, M. A., is an economist, broadcast commentator and London editor of the *Eastern Economist*, New Delhi. He is the author of several books, including *The European Common Market: What Will it Mean to You.*

Mr. G. E. Tewson graduated from the University of Glasgow in economics and is now a partner in the firm O. W. Roskill Consultants.

Field Computations in Engineering and Physics. By A. THOM and C. J. APELT. *Van Nostrand.* (30*s*)

The numerical solution of partial differential equations in two dimensions by Professor Thom's Squaring Method, first developed in the 1920's for the solution of non-linear hydrodynamic equations. A large amount of space has been devoted to Laplace equations, since a preliminary Laplace solution makes it easier to handle non-linear problems.

Large Elastic Deformations and Non-Linear Continuum Mechanics. By A. E. GREEN and J. E. ADKINS. *Oxford University Press.* (55*s*)

A systematic exposition of some of the main topics of the non-linear theory of large elastic deformations. An examination of the strain energy function for the crystal classes and various forms of the stress strain relations is followed by chapters on exact solutions, plane strain, plane stress and membrane theory, and approximation methods.

Marketing

Chemical Plant Contracts in USSR

ONE THOUSAND MILES East of Moscow two chemical plants, to make weed killer and the resin base for drip dry materials, are to be built by WYCON SERVICES, the exporting company jointly owned by the FISONS company and CONSTRUCTORS JOHN BROWN. The £2 million contracts were signed at the Leipzig Fair by a Wycon director and a representative of the Soviet trading organisation TECHMASHIMPORT. Wycon is understood to be engaged in negotiations over a further substantial contract.

The two plants will be built by Russian workers with three British companies providing the technical supervision; they are, Constructors John Brown, the industrial chemical Fisons' subsidiary WIFFEN AND SONS, and FISONS PEST CONTROL.

The weed killer plant, based on the Harston, Cambridgeshire, Fisons' plant producing the MCPA weed killer will have four times the annual output of the Harston installation. This should give weed killer sufficient for the treatment of 11 million acres a year.

At the Loughborough works of Wiffen and Sons a group of Soviet engineers will be trained in the operating techniques of the DMEU resin plant producing resin from which fabric for 500 million garments can be treated annually.

Diesel Prospects from Leipzig Visit

Useful contacts at top level in East Germany have been made through the FAIRFIELD SHIPBUILDING AND ENGINEERING Company's stand at the Leipzig Fair. Mr. Kenneth Mackay, the company's engineering commercial manager, was invited by Herr Walter Ulbricht, the East German head of state, to discuss the diesel engines and other equipment needed in East Germany's 1962 shipbuilding programme.

Fairfield, who are also exhibiting at the Moscow British trade fair in May, are conducting serious talks with the Russian embassy's trade department on details of Fairfield turbines. They are also in touch with a Polish buying delegation.

East German executives were showing lively interest in the G. AND J. WEIR'S large seawater evaporation plants which handle 500,000 gallons of seawater a day and cost from £150,000 to £200,000. The applications the East Germans have in mind are for power stations now being planned for sites along the Baltic coast.

£40 Million Order Lost to France

A less happy story from East Germany concerns an order worth between £40 and £50 million for which British steel firms were first approached but which was subsequently gained by French interests.

The contracts were for rolling mills and other steel making equipment to be installed in plants at the new steel city of Stalinstadt, East Germany. The East Germans wanted to spread the payments over three years but the Export Credits Guarantee Department were not willing to make available the facilities that would have been required.

Under the deal arranged with the French, the East Germans will be provided with credits of £7·5 million each year, spread over a five year period.

Thornybank Industrial Estate Plans

Forty acres of the Buccleuch Estates, at Dalkeith, outside Edinburgh, are to be developed as the THORNYBANK INDUSTRIAL ESTATE, with government financial help, subsidised and integrated housing development, and the LAING DEVELOPMENT Company acting as advisers.

The Thornybank site, on the northern side of Dalkeith, is divided by the B6414 road which will in time connect the factories of the estate with the future Dalkeith by-pass on the A68, Edinburgh's trunk road to the south, and the Dalkeith ring distribution road linking the estate with the Dalkeith and Newbattle residential areas.

The area of the site is free from mining subsidence and the sub-soil has a good bearing capacity. Water, gas and electricity services will be available and estate roads and footpaths will be provided without charge to the incoming company.

First of the newcomers to the Thornybank estate are FERRANTI Limited. Their full plan is to build laboratories and works over some 250,000 sq. ft of floor space.

Factories over 5,000 sq. ft floor area require a Board of Trade certificate that the proposal complies with the approved distribution of industry. Dalkeith is in Midlothian, which is classified as an overspill district—a receiving area for part of Glasgow's excess population. Managements able to show that the building of their factory will create new jobs in the district are expected to have a smooth run in securing full official support for their project. The Board of Trade's loans are intended to cover:

Factory building costs,
Plant, machinery and equipment costs,
Provision of working capital.

Repayment, usually at a little above Bank Rate, can be spread over ten years, or may, in the case of a new business, be remitted for the first year or two. Loans are to be granted on condition that it can be shown employment will be created for people from Glasgow. The prospects of obtaining financial help are therefore in ratio to the proportion of Glaswegians to be employed.

An industrial selection scheme has been worked out by the Corporation of Glasgow in cooperation with the Ministry of Labour. The Corporation keep up a register of Glasgow workers willing to transfer from the city, showing their occupation and industrial background.

Midlothian County Council will build houses in the Dalkeith-Newbattle area for employees recruited under the industrial selection scheme. They will be available at subsidised rents which at the moment are as low, exclusive of rates, as 9*s* and 11*s* 6*d* per week. It is intended that the houses shall be available more or less in time with the completion of the factory.

Where key workers are not available through the selection scheme or in certain cases where the company moving in wish to transfer men from other branches, local authority housing will be made available even where the men come from outside Glasgow.

Five miles from the centre of Edinburgh, Dalkeith is a 10,000 strong Scottish lowland town in the process of beginning its expansion to a 20,000 population. Lying between Edinburgh, the coast and the border country it seems a pleasant place in which to consider setting up a new works.

Avon Jets Reach 2,600 Hour Overhaul Life

Approval for a 2,600 hour overhaul life for ROLLS-ROYCE Avon engines has been given by the AIR REGISTRATION BOARD. Avons are the jets used by the Comet fleet of the BRITISH OVERSEAS AIRWAYS CORPORATION. A 2,600 hour life means flying more than a million miles in the scheduled life of an engine.

The Avon jets, as well as steadily building up the period between overhauls, have an unusually low maintenance requirement. Total maintenance work, including scheduled and unscheduled engine removals and reinstallations, is less than four man-minutes in each engine hour.

The attainment of 2,600 hours between overhauls is the latest step up from the previous 2,300 hours. This was the point the Avon had reached from its introduction in October, 1958, on the first transatlantic jet flights with the BOAC Comets, when its life was 1,000 hours. Selected engines are now going on to an overhaul life of 2,900 hours. These life periods do not involve any scheduled part-life inspections or changes of components.

Austin Seven Used for Caravan Sales Tour

Not many sales tours have to be stopped ahead of time because of their success. This is what happend to the tour through five Continental countries of two County Durham housewives who were towing a Nymph caravan behind an Austin Seven saloon.

Within 17 days, moving through France, Belgium, Holland, Germany and Switzerland, sufficient orders were taken to keep the NEWTONE COACHWORKS, for whom the tour was being made, busy for the next 18 months.

The baby Austin hauled the caravan for about 3,000 miles, over all kinds of roads and at high speeds, without any need for technical attention above the usual lubrication. When the coachwork firm have expanded their production facilities the tour will probably be repeated.

Chemical Plant to be made in Mexico

The London chemical engineering designers and constructors KESTNER EVAPORATOR AND ENGINEERING have concluded a licence agreement with DICON SA DE CV, of Mexico City, for the production in Mexico of Kestner chemicals plant, including crystallisers, driers, chemical evaporators and acid-proof equipment.

The Mexican company have also been granted a licence for the manufacture in Mexico of the heat transfer equipment of RICHARD M. ARMSTRONG, of Pennsylvania, USA.

Automated Roller System Offers Traffic Solution

Speeds of up to 150 mph by car without switching on the engine are envisaged by WESTINGHOUSE ELECTRIC INTERNATIONAL engineers who have devised an automated roller-road system. Their idea is that cars, with their passengers, would be carried in trains on the road, which would run between guide rails with large rubber rollers spaced 20 ft apart providing the driving force.

Each roller would be separately powered by a motor, which would run only when the train was passing over it. The system would be operated by the use of a computer, governing the loading and unloading of cars at stations.

Westinghouse are to provide the propulsion equipment for 28 new subway cars for New York City under a contract awarded to WESTINGHOUSE ELECTRIC CORPORATION by the ST. LOUIS CAR COMPANY. The St. Louis company is manufacturing the new cars for certain divisions of the NEW YORK CITY TRANSIT AUTHORITY.

The new contract is in addition to a previous contract for 130 sets of propulsion equipment for the New York system. The value of the total of 158 sets is estimated at over $6 million (£2,140,000).

No Hump on these Gipsies

Twelve Austin Gipsy four-wheel drive 15 cwt. vehicles have been ordered by the COLUMBIA PICTURES CORPORATION and HORIZON BRITISH PRODUCTIONS for use in the difficult conditions of the Jordanian desert. They are to be used for carrying heavy equipment and the people making the British film Lawrence of Arabia.

It is understood that the four-wheel drive Gipsies will be able to reach inaccessible desert locations which even the broad footed camel is unable to penetrate. The twelve vehicles will carry a complicated array of equipment —winches, drawbars for heavy trailers, rear power take-offs and pulleys. High cross-country cruising speeds are expected of the Gipsies, which are going by sea and should be in Jordan by the middle of this month.

New Light Plane at Farnborough Show

No time is being wasted by BEAGLE, the PRESSED STEEL group's subsidiary BRITISH EXECUTIVE AND GENERAL AVIATION Company, in presenting their products.

The first of BEAGLE's aircraft is to be shown at this year's Farnborough, the Society of British Aircraft Constructors' flying display and exhibition. Until the company are ready to reveal their new aircraft to the market they intend to maintain complete commercial security. A high percentage of the business visitors to Farnborough are overseas executives, making the show a particularly valuable launching site for BEAGLE, who expect more than two-thirds of their business will be for export.

Holman Silver 3 Handril

No piece of equipment is more thoroughly abused than a rock drill. Design can only progress as a result of long experience, backed by continuous research and testing under actual working conditions.

IF THERE is one engineering product which, almost literally, spends its life bashing its head against a brick wall, it is the rock drill. In seeking to carve a hole through solid rock, the drill must sooner or later destroy itself—it is simply a matter of time.

Holman Brothers Limited, Camborne, Cornwall, manufacturers of the Silver 3 Handril, have a simple philosophy. Sooner or later every rock drill sold is going to need replacement of major components. At the same time, every customer expects a certain amount of usage from his new drill without replacing anything more than the drill bit. So a balance has to be struck between the unprofitability of making the drill over-robust and too heavy in an effort to prolong its life; and the undesirability of forcing the customer to start buying new parts too soon.

With a rock drill, the conditions under which it works are such that no manufacturer could afford to offer a written guarantee to go with it. Therefore the manufacturer has to rely on an established reputation for high class engineering design and workmanship, backed by a service and spare parts organisation giving world-wide coverage. Both require a period of many years to build up, and so clearly an entry into the rock drill market is not likely to appeal to any firm new to the game.

The Holman concern was founded at Camborne in 1801 by Nicholas Holman. Camborne was the centre of a hive of mining industry during the 19th century, and Nicholas Holman was associated with the great steam engine pioneer, Richard Trevithick, at the time when the latter was wrestling with the problems of improving and expanding the use of steam power in the mines. Three other big engineering firms grew up close to the mining districts of Cornwall to keep the mines supplied with engines and equipment, together with two smaller firms at Camborne supplying rock drills—but only Holmans survive today.

The reason why the periodic depressions in mining, which culminated in near-extinction of the industry in Cornwall, did not put Holmans out of business too can be summarised in one word—diversification. They developed a family of products of which the rock drill quickly became pre-eminent; and also built up a large overseas market on which they largely depend nowadays for the sale of mining equipment. Prior to 1880, when John Holman (son of Nicholas) retired, and handed the business over to his two sons John Henry and James Miners Holman, the firm's mainstays were small steam and compressed air engines, air compressors, crushers and hoists.

Attempts to mechanise the operation of drilling holes in rock for the insertion of explosive started about 1850, and both steam and compressed air were tried as the power medium. It was 1881 before Holmans added rock drills to their range of products, in which year John and James Holman took out a patent with one, James McCulloch, an inventive Scotsman, for "an improved machine for drilling or perforating rocks," which was the prototype of the celebrated Cornish Rock Drill. These machines were of the reciprocating piston type, from which many designs were later copied. They finally gave way to the modern "hammer drill" type shortly before the First World War.

The Cornish drill was an immediate success in the local mines and was soon also in demand overseas. Credit for the most significant invention concerned with rock drills must, however, go to a Mr. George Low of Ipswich, who in 1865 had invented the spiral bar and ratchet mechanism for gradually rotating the drill steel in addition to the main percussive action. This principle is still standard throughout the industry, despite many attempts to improve on it.

The difference between hand and machine drilling in the mines was spectacular. Apart from the sudden relief of the miner's drudgery, improved ventilation was an important fringe benefit. On the other hand, the amount of dust released by a drill made mining a far more dangerous occupation than hitherto.

COMPARISON OF PARTICULARS

	Silver Bullet	*Silver Three*
Performance in Cornish granite using 1⅛ in bit	12¼ in per min	15 in per min
Air pressure	80 lb per sq. in	80 lb per sq. in
Number of blows per min	1,900	2,500
Free air consumption	94 cfm	120 cfm
Weight	60 lb	49 lb
Cylinder bore × stroke	2⅝ in × 2¼ in	3 in × 1⅝ in

Both the Silver 3 and the Cornish rock drill are similar in effect that they are both rotary and percussive, but the percussive action in each is entirely different. The Cornish drill has a slow, heavy "follow through" type of blow (from 250 to 300 blows per min), while the Silver 3 has a sharp rapid action (2,500 blows per min), which makes it ideal for tungsten carbide drill bits. In both machines the drill steel is rotated so that each blow delivered by the forward stroke of the piston will drive the bit into a fresh place at the bottom of the hole. Rotation is usually between 15° and 30°.

The drill steel comprises the tip (carrying the bit), rod and shank. When using a hand-held Silver 3, a steel about 2 ft long is used to start with, and as the hole deepens by each 2 ft a longer steel is inserted. Holes up to 20 ft deep are common practice and, in some types of rock, up to 70 and 80 ft. In softer rocks the hole diameters vary little from start to finish, but in hard rock it is usual to fit a slightly smaller bit on each change of steel to prevent binding and damage to the bit. When the machine is mounted on a cradle or an "Airleg," which is usual practice underground, steel changes are much less frequent, especially with tungsten carbide bits.

Early Cornish machines drilled about 5 in per min and weighed about 350 lb. Compare this performance with that of the Silver Bullet, Holman's main "bread-and-butter line" before the Silver 3 appeared in 1953, and the Silver 3

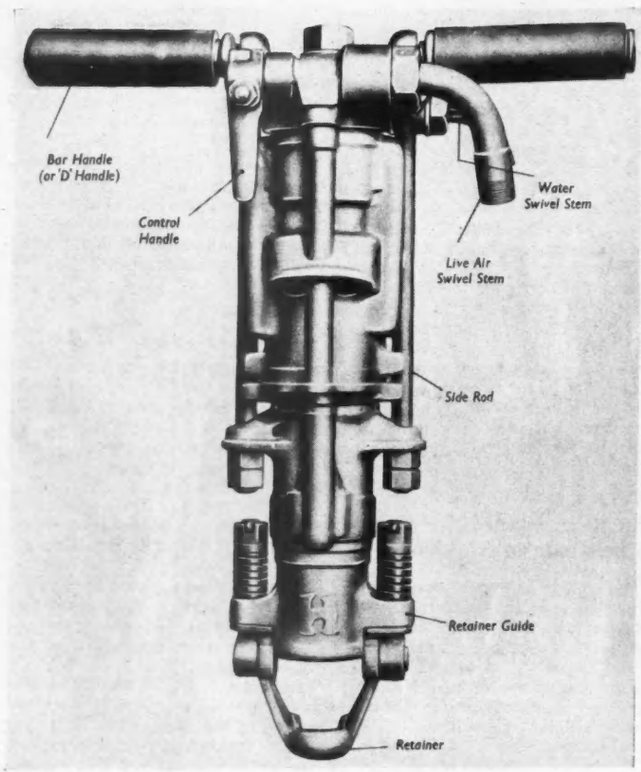


Fig. 1 (left) The Silver 3, streamlined and functional.

Fig. 2 (below) Silver 3 with a D-handle and mounted on an Airleg.

Fig. 3 Driving through solid rock with a tool weighing only 50 lb.

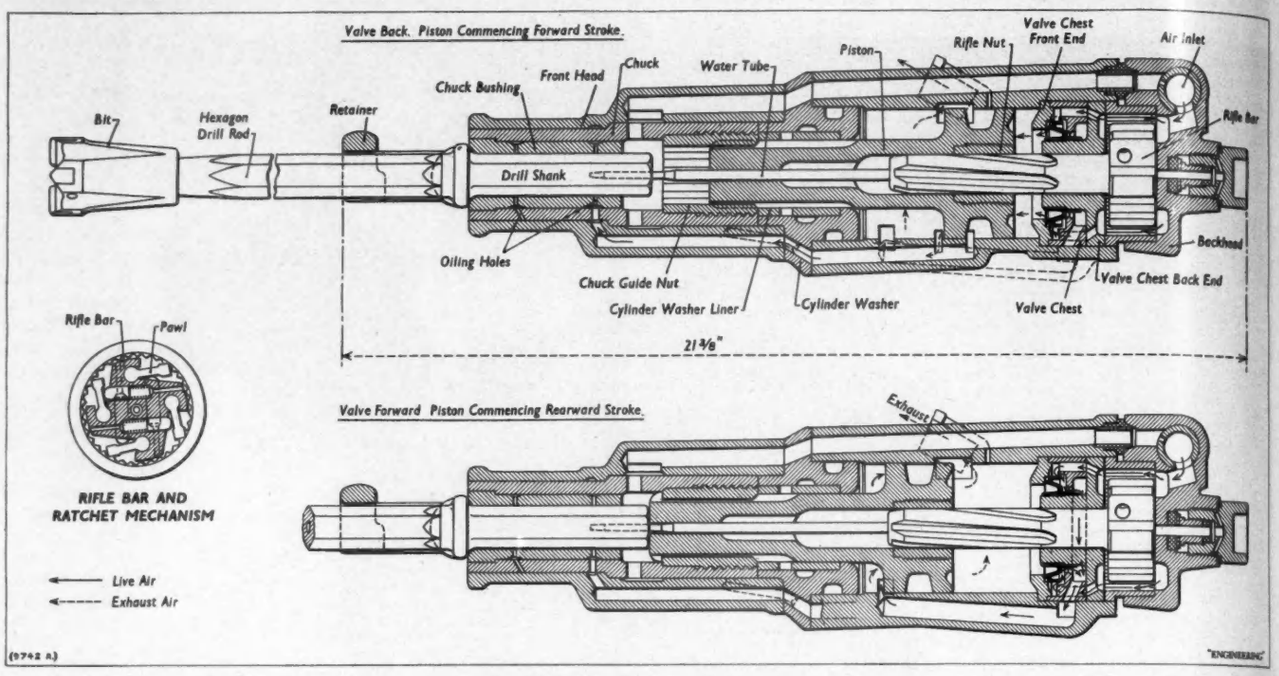


Fig. 4 Sectional views showing operation.

itself in the accompanying table.

Besides ability to meet a specified performance, to be a success a rock drill must be:

(1) easy to maintain and not greedy on replacements,
(2) light, responsive and easy to handle, and
(3) economical in air consumption.

The Silver Bullet was so successful that it is still sold today, and would probably have retained its leadership had it not been for the introduction of tungsten carbide steel tipped drill bits, which demand faster and lighter blows for optimum performance. The Silver 3 promises to be at least as successful as its predecessor, and Holmans informed ENGINEERING that they aimed for certain characteristics and confirmed them in their first prototype machine.

Apart from "know how," proving a new drill under working conditions is essential. Holman have their own test mine in Cornish granite up in the hills three miles from Camborne. There, in addition to proving new designs, every drill is put through its paces before dispatch. Any machine whose performance is below standard is returned to the works for investigation.

OPERATION

Fig. 4 shows the piston in the two extreme positions and the arrows indicate the flow of live and exhaust air through the machine. Arrows showing the route of the live air are drawn in full, and the exhaust arrows dotted. Rock drills, incidentally, are usually lubricated by means of a line lubricator inserted in the air hose a few feet from the machine inlet. When the annular valve is in the right-hand position, as in the upper view, air is admitted direct to the head of the piston forcing it forward. As it travels forward it uncovers ports just prior to the exhaust admitting a small quantity of oil-laden air from the cylinder direct to the drill chuck, where some of it passes through holes in the chuck bushing and on to the drill shank. At the same time exhaust air is expelled.

In the lower view the piston has just struck its blow on the drill steel and the valve has moved to the left-hand position. Live air is passing through the opposite channels to the front of the piston to complete its rearward stroke. Meanwhile the exhaust air is again passing to atmosphere through the port in the side of the cylinder. It will be noticed that the exhaust port is so positioned that a cushioning effect is provided by the exhaust air in both directions of travel, thus minimising shock in the mechanism and economising in live air consumption. The lubricating ports in the cylinder are equally effective on the rearward stroke of the piston.

On the backward stroke the spiral bar and ratchet mechanism rotates the piston by means of a rifle nut in the piston engaging with a slow helix on the rifle bar. The rifle bar is prevented from rotating during the backward stroke of the piston by a "free wheel" ratchet mechanism engaging with the backhead. The drill chuck also carries a guide nut engaging with splines on the piston, so that as the piston rotates it takes the chuck, steel, and drill bit with it.

Provision for introducing water down through the centre of the piston and the drill steel to the bit is made on every Silver 3 machine for underground use, to allay the dust.

The basic Silver 3 drill can be supplied with either a bar handle as shown in the drawing, or a "D" handle to permit mounting on an Airleg or in a drilling rig. Other variations are all based on the same machine, but the simple hand-held drill accounts for about three-fifths of production. An Airleg is a telescopic rearward-extending leg under controlled air pressure, for supporting the weight of the drill and providing the required feed pressure.

The recently introduced Silver 33 has a built-in Airleg with its control and the drill controls grouped together on the drill backhead. The Silver 30 is a special adaption for conditions where a low air consumption is of major importance, controlled to 95 cu. ft at 80 lb per sq. in. The Autostoper is a special combination of Silver 3 plus air-operated feed cylinder for vertical drilling or "stoping."

THE MARKET

Holman's manufacture rock drills on a batch basis, and in some cases slight changes are made to meet customers' special requirements. Without going into the design of the bits, which are a story in themselves, the introduction of tungsten carbide steel tipped bits after the war made possible one of the biggest forward leaps in rock drill performance in their history, which led directly to the Silver 3.

The mining industry is notorious for its ups and downs, and the long life of Holman Brothers proves the wisdom of diversifying products and widening the market. Nevertheless, they still have a big production continuity problem. Mining throughout the world is depressed at the moment, a condition which affects all their mining products, including compressors, hoists, drill bits and air motors. Outside mining, they manufacture stationary and portable air compressors, and pneumatic tools, while associate companies' interests include Maxam control equipment, Goodyear positive displacement pumps and Dustructor industrial dust control control equipment.

About 70 per cent of the Silver 3s turned out at Camborne go abroad, Australia and Canada being the biggest users. Silver 3s are also made by associates in Spain and India and under licence in Poland, and its success extends behind the Iron Curtain. Several shaft sinking records have been established with Silver 3s.

The Silver 3's purchasers are mainly mining and shaft sinking companies and civil engineering contractors. The last of the great Cornish tin mines, South Crofty, near Camborne, and Geevor, near St. Just, are being supplied.

One special difficulty in designing a rock drill is that of trying to reconcile the varying requirements of customers in different parts of the world. As an extreme example of the problems involved, the Silver 3's weight lies just within the maximum permissible figure of 50 lb for one-man operation in Australia; yet South African requirements demand a special version with a reduced rate of heavier blows, the HA275. This machine is now made in South Africa.

Holmans are easily the biggest engineering concern in Cornwall, and the Group employ about 2,500, mostly at Camborne. Many of the staff have given the firm a lifetime of service. Local folk, some of whom have never travelled farther afield than Plymouth, still refer to Holmans works affectionately as "up foundry"—a reminder of 1879 when John Holman described himself as "Brass and Iron Founder—Manufacturer of . . . and Mining Machinery of Every Description."

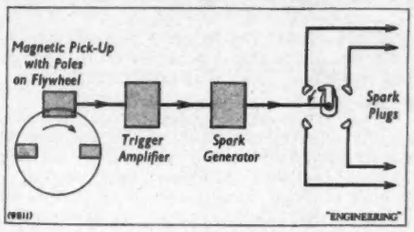
Electronic Ignition for Racing Cars

Joseph Lucas Limited are developing a patented ignition system for racing purposes in which the high-tension voltage is produced entirely by means of an electronic circuit.

The development of multi-cylinder high-compression high-speed engines both for cars and motor cycles means that existing coil and magneto systems may be unable to meet the increasingly critical ignition requirements of sparking speed and timing accuracy imposed by these engines. Mechanical considerations of contact breaker design and other factors restrict operating speeds of the existing systems to about 400 sparks per second in the case of coil ignition and 500 sparks per second for magnetos. In addition timing accuracy may be affected to a small degree by backlash or torsional oscillation in the drive mechanism, and also by wear to which the moving parts are subjected.

In the new Lucas system, a spark rate of 1,000 per second is a practical proposition, equivalent to an eight-cylinder engine running at 15,000 rpm. Moreover, the spark voltage is constant over the entire speed range. Ignition timing is determined by an electromagnetic triggering device associated with the engine flywheel, this being the engine member least affected by torsional oscillations and wear, so that extreme accuracy of timing is maintained. Automatic timing controls responsive to both engine speed and load can be incorporated when required.

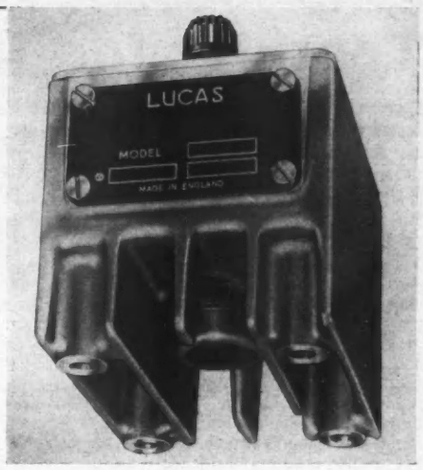
Basically, the system comprises an electromagnetic pickup associated with pole pieces attached to the engine flywheel (or in a light wheel fitted to the opposite end of the crankshaft for convenience), a trigger amplifier, a spark generator unit and a high-tension distributor.



Simplified layout of Lucas electronic ignition system for a four-cylinder engine.

As the engine rotates, a voltage impulse is produced at the pickup each time one of the pole pieces passes within its field. This pulse is applied to the trigger amplifier, which can be considered simply as a normally closed switch, allowing current to flow through the primary winding of a trigger transformer. The voltage pulse results in this "switch" being opened so that current flow through the primary ceases.

The energy released by the resulting collapse of current induces a voltage in the trigger transformer secondary winding, and this in turn causes a current to flow in the base circuit of the spark generator unit. An associated transistor thereby becomes conducting, so that current flows in the primary winding of a high-voltage transformer. A regenerative oscillation is initiated, resulting in a very rapid increase in primary current, which gives rise to an induced voltage in the transformer secondary of over 20 kV. This voltage is applied to a rotor arm and is distributed to sparking plugs in the normal way. Regeneration ceases when the transformer is saturated, and the transistor again becomes non-conducting. The complete cycle time for regeneration is less than 200 microseconds. With the cessation of the voltage pulse at the pickup, conduction again commences in the trigger amplifier circuit in readiness for the cycle to be repeated at the next pickup pulse.



The spark generator unit for the Lucas ignition.

Lucas emphasise that this system is still under development to meet the possible ignition needs of advancing racing-engine designs. For standard production vehicles, the present ignition is perfectly adequate and will continue to be employed.

Mercedes and DKW Junior

Two weeks ago (ENGNG., 24 March '61, p. 410) Gordon Wilkins drew attention to the significant fact that the coupé version of the Mercedes 220SE is the first German car to be fitted with Girling disc brakes, having them on the front wheels only. Now Daimler-Benz have gone a stage further by fitting a hydraulic four-wheel Dunlop disc braking system with booster on the Mercedes-Benz 300SL touring sports car.

It has been possible to install disc brakes at both front and rear on the 300SL because, with its low centre of gravity, braking places a uniform dynamic load on the front and rear wheels. The hand brake system has two auxiliary brake shoes operating on the discs of the rear brakes. Good heat dissipation with disc brakes is effected on the 300SL by positioning the disc in the air flow and by causing it to expand not in the direction of the braking pressure but at right angles to it.

The Daimler-Benz company say, however, that the use of disc brakes on the 220SE and the 300SL does not necessarily indicate a general switch to this type of braking on their cars. Already their drum brakes have been developed nearly to the blocking limit—i.e., the point where frictional contact between the tyres and the road is lost—and it would be dangerous to approach too near to this physically conditioned limit.

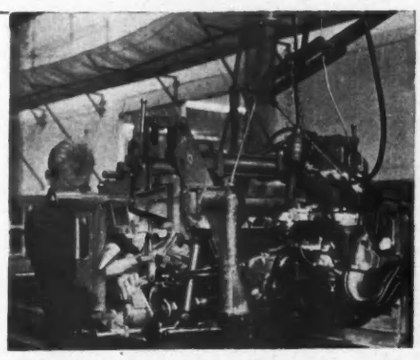
The Mercedes-Benz 220SE coupé is fitted with British Girling disc brakes at the front.

The new 220SE, shown below left, has other interesting features. Front springs and anti-roll bar are stiffer and the steering gear has a greater reduction to make parking easier. Durability of the telescopic dampers has been increased by the use of a new material for the seals which enables them to operate satisfactorily at temperatures up to 200° C (previous limit 120° C) and these gave good service in the saloon which won the Central Africa Rally. Modification of the governor on the fuel injection system now permits the engine to accelerate at full throttle immediately after starting at temperatures as low as minus 30° C.

Daimler-Benz are amalgamated with Auto Union whose latest product, the DKW Junior, is a contrast in size with the 220SE and the 300SL. These three-cylinder, two-stroke cars are produced at a rate of 240 per day at a new factory at Ingolstadt, near Munich. Two production sections are shown on the right.

The DKW Junior has a separate chassis with box-section side members made of two sheet-metal top-hat sections automatically seam welded together in an ingenious machine with travelling electrical welding heads. American sheet steel is largely used for body panels. Before installation every engine is bench tested for power output and fuel consumption. Price of the car on the German home market is £399.

The new factory was only started in July, 1958, on a site where work was delayed by a number of unexploded bombs which had been dropped during the war, but the first car came off the line in August, 1959. There are two floors with the press shop extending through both floors. Car assembly lines are on the upper level, fed with parts and materials from the main floor. Railway tracks parallel to the delivery hall allow cars to be loaded into special wagons for transport. The present plant has a ground floor area of 410,000 sq. ft, but a second hall of the same size is now coming into use and a second assembly line will push capacity up to over 400 vehicles a day.



Optical rig for adjusting castor, camber and toe-in on front suspension of DKW Junior.

Three-cylinder two-stroke engined DKW Juniors on fixed assembly line at Ingolstadt plant.

Testing for Life on Aircraft Components

Dowty Rotol Limited design and manufacture a wide range of aircraft accessories. Two of these—landing gear and propellers for civil aircraft—call for unusual fatigue research.

IN THE design and construction of aircraft, there is a general trend to dispense with the singular prototype, in favour of a first batch of ten or more aircraft which precede the main production run. This first batch of aircraft is constructed using a large proportion of the production tooling, to speed the construction, minimise the cost and preserve interchangeability with subsequent manufacture. To do this, the aircraft manufacturer has to have faith that his product is substantially correct without going through the exercise of making a trial sample. Similarly, the accessory manufacturer who supplies components for the aircraft must make his equipment from production tooling and be certain they are also substantially correct.

The design, therefore, is committed to production before any testing is carried out and before any testing of the aircraft to establish that the design requirements are correct. The techniques of structural design for static strength have been established over many years whereas designing for fatigue life continually presents new and unsolved problems. The fatigue experiments described in this Report serve two purposes—firstly to assess the correctness of the design and secondly to form a research basis for future designs.

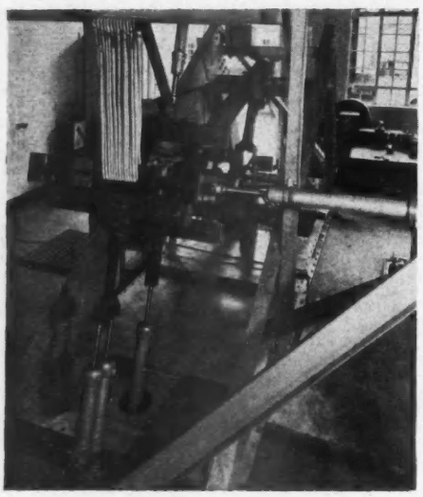


Fig. 1 Fatigue life-test apparatus to impose vertical and side loads, drag loads at rolling radius, drag and anti-drag at the axle, on undercarriage gear.

Research Report

on the work of

Dowty Rotol Limited, Cheltenham, Gloucestershire

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Chief Mechanical Test Engineer (Arle Court Division)
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The emphasis in all fatigue research for civil aircraft is passenger safety. The designer is usually faced with the formidable task of keeping his safe life-assessment ahead of the maximum number of flying hours achieved by aircraft in airline service, since laboratory experiment and service use of the aircraft are usually running simultaneously in the early months.

It is of interest to put into perspective the problem of designing-in a satisfactory fatigue life for the modern aeroplane. For example, consider the Friendship (F 27) aircraft, built by Fokker in Europe and Fairchild in the USA. This short range twin-engined airliner, a replacement of the ubiquitous DC 3, has been in service only two years, yet already aircraft of this type have each exceeded 10,000 landings and take-offs, involving 5,000 hours flying. These aircraft have a minimum life expectation of 10 years during which time they will probably make 50,000 take-offs and landings and 25,000 hours of flying. In terms of miles travelled, 25,000 hours represents approximately 6 million miles in the air and about 100,000 miles taxi-ing.

Not all the parts of the aeroplane will last the total life but the designer's object is to have as few replacements as possible and this is certainly the object of the airline operator who has to pay for the replacement parts. To the manufacturer of undercarriages and propellers, this type of short haul feeder line aircraft poses the worst problems, since the life of both propellers and undercarriages is largely related to the number of landings and take-offs. An important difference between the fatigue problems of undercarriages and propellers is that the former are subject to intermittent high loads, whereas the latter work continuously under low level vibration loads.

Undercarriage Fatigue

As an example of the fatigue research that accompanies design, consider a typical main undercarriage for a civil aeroplane, such as the main landing gear for the Armstrong Whitworth Argosy freighter-passenger aircraft. This landing gear meets the strength requirements of the British and the American airworthiness authorities and was designed to have a fatigue life of 15,000 landings. Static strength tests were carried out before the first flight, followed by strain gauge measurements during landing and take-off. Full scale fatigue testing of the landing gear started at about the same time as the first flights using a specimen from the production manufacturing tooling. These tests were carried out on the landing gear alone but were coordinated with the tests which the aircraft constructor carried out on the wing structure. One of the apparatus used for these tests is shown in Fig. 1.

To simplify the tests, they were broken down into two parts: one apparatus being used to apply loads representing landing and ground manoeuvring, and another apparatus to apply both landing and retracting loads to the relevant parts of the structure.

In attempting to arrive at a suitable loading spectrum, which can be applied to represent typical landing and ground load conditions, the designer finds that there is a very limited amount of information available. Experience has shown that the braking during landing and the engine run up conditions produce greater undercarriage fatigue loads than those occurring during the touchdown. On the main undercarriage, a further factor which has been shown to have a large influence on the fatigue life is the degree of wheel brake "chatter."

However, the spectrum itself varies from aircraft to aircraft and is influenced by such factors as aircraft controllability, the pilot's view, the undercarriage landing and suspension characteristics, and the runway and taxi-ing surfaces on which the aircraft has to operate.

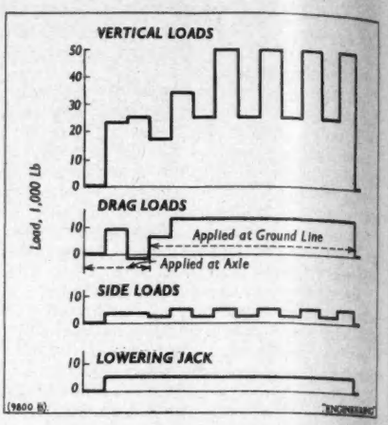

Fig. 2 Fatigue loading chart for main undercarriage of Armstrong Whitworth Argosy.

The designer, whilst taking account of this information also draws on past experience with the result that a simple practical loading spectrum is derived for test purposes, which is designed to produce the same degree of "damage" per landing. Such a spectrum is shown in Fig. 2. These loads, together with those appropriate to the retraction and lowering of the landing gear are applied to a single test specimen until failure occurs or a satisfactory life is established. During these tests, the specimen is inspected at regular intervals and checked with a dye penetrant solution for cracks.

It is important to observe the onset of cracking, the rate of propagation of cracks and the life to failure. Premature failures during the test will be locally "patched" to enable the test on the remainder of the structure to continue.

In accordance with British Civil Airworthiness requirements, a test on a single specimen must show a life of 6 times that required in service to cover scatter of results. Fig. 3 shows the relationship between the number of test specimens and the scatter factor required. Where a small part fails to achieve a factor of 6, it is often convenient to test several more specimens to take advantage of the reduced factor. Failures fall into two very important categories—critical and non-critical. The former are those that occur rapidly with little or no warning and the latter are those where cracks form slowly, at a rate which would enable them to be found during normal aircraft inspection at overhaul.

Clearly, the non-critical parts give on average many times the useful life of critical parts, since the latter must be life-rated to the lowest value expected of any sample. To the airline operator, it may mean the purchase of two or three spare

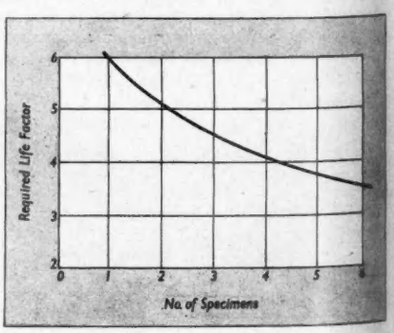

Fig. 3 Relationship between number of specimens tested and the required life factor.

parts in the same period which would obtain if the type of failure were non-critical.

These tests are, of necessity, accelerated to give a workable time scale, but great care must be taken to ensure that artificial conditions do not cause non-representative failures.

Another problem which has gained prominence is "fretting." Not only is this phenomenon a nuisance in its own right but it can lead to unduly early fatigue or corrosion fatigue failure. To reduce the deflections during testing and hence the power required for these tests, it is usual to fill the shock absorber and actuator with a low compressibility fluid such as glycerine and water and, once again, artificially restrict the shock absorber deflection to a narrower range. This may well cause local damage which is non-representative of service conditions.

The results from this first test are used to fix safe lives for all the parts of the structure and mechanism and to confirm the basic design. If the lives found are unsatisfactory, redesign is carried out and further tests are made (usually of local specimens) to prove the design changes. During the service life of the aircraft, unbroken parts will be withdrawn from service and retested in the original apparatus and manner in order to establish the remaining life. Thus, by comparison with the original test specimens, the validity of the test assumptions can be assessed.

During service, some failures may occur which were not produced in the original tests. If there is no explanation of these unanticipated failures, retesting to a new loading spectrum will be required, To complete the cycle, this will lead to a re-evaluation of the safe life of the components and inspection periods.

This cycle of events is shown in Fig. 4 and represents the continual cycle of research and development which carries on in parallel with the life of the aircraft in service, progressively getting nearer the truth as the life of the aircraft proceeds, and providing a new set of data on which to base the fatigue design of the next aircraft landing gear.

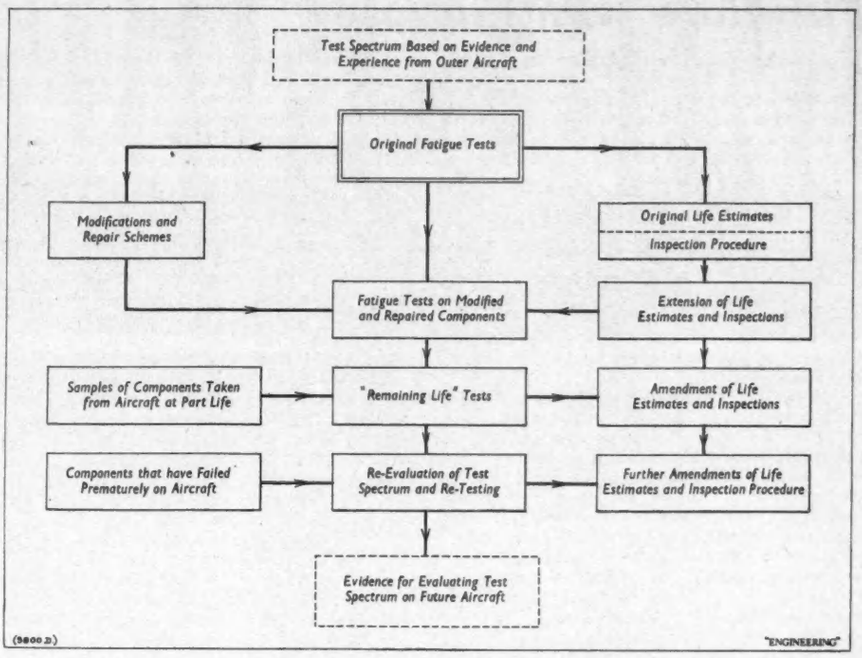
Test Spectrum Based on Evidence and Experience from Outer Aircraft
Original Fatigue Tests
Modifications and Repair Schemes
Original Life Estimates
Inspection Procedure
Fatigue Tests on Modified and Repaired Components
Extension of Life Estimates and Inspections
Samples of Components Taken from Aircraft at Part Life
"Remaining Life" Tests
Amendment of Life Estimates and Inspections
Components that have Failed Prematurely on Aircraft
Re-Evaluation of Test Spectrum and Re-Testing
Further Amendments of Life Estimates and Inspection Procedure
Evidence for Evaluating Test Spectrum on Future Aircraft
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Fig. 4 Cycle of research and development carried out in parallel with aircraft service life.

Propeller Fatigue

A propeller is subjected to loading by centrifugal force, propulsive thrust and vibratory stresses set up by aerodynamic excitation, throughout the whole time its engine is running. However, the vibratory stresses represent the major proportion of the factors affecting the fatigue life of the main components, and they are determined by flight strain gauge tests, which are a mandatory requirement for each propeller type and for each aircraft application. Such tests must cover all possible flight conditions and likely manoeuvres within the flight envelope for the aircraft concerned. By this means the vibratory stress levels are established for the propeller blade and blade root retention system.

Fatigue tests on new components then provide curves from which the fatigue limit or maximum stress level for theoretical infinite fatigue life may be obtained.

It is essential that the stress values measured in flight are sufficiently below the fatigue limit to provide a generous safety factor. This will ensure safe operation for a considerable time ; however, it is believed that additional tests should be carried out to see whether any deterioration occurs as a result of service operation.

Fig. 5 Propeller test rig, showing shortened blade with strain gauges attached.

Dowty Rotol Limited have, therefore, initiated a test programme in collaboration with many airline operators whereby major components, such as blades, blade bearings and hubs, are recalled from service operation at progressively increasing stages and subjected to fatigue tests under conditions similar to those used for new components. By this means a continual check is kept of the fatigue standard of propellers in service so that, if deterioration occurs, corrective action may be taken as early as possible.

Furthermore, by selecting for test at any given time the component parts with the highest available flying hours, it is possible to obtain an assessment of fatigue strength in advance of maximum service hours.

The programme of testing has, up to date, included components with service lives ranging from 2,000 to 12,500 hours and is continuing with parts at even higher hours.

Propeller blades are often reduced in length for these tests since it has been found from experience that it is difficult to simulate exactly the vibratory stress distribution of flight on a fatigue rig due to the different forms of excitation and blade loading. In flight the blade vibrates under thrust, centrifugal and aerodynamic loads and excitation is brought about by a complicated distribution of loading along the blade. The state of affairs on the rig is different since, for practical reasons, point sources of excitation are used. However, it has been found that by cropping the blade the location of the maximum vibratory stress can be moved much nearer to the blade root to eventually coincide with the desired position.

The testing of hubs is carried out in a rig in which the centrifugal loading is applied from a hydraulic jack through a lever and rod and the bending loads by adjusting the length of the eccentric rod; which also applies the vibratory loads by means of a variable throw eccentric.

The form of rig used for the vibration of blades is as shown in Fig. 5, from which it will be seen that the blade is suspended by the root end from a pivoted platform, and vibrated by means of a moving coil vibrator at a resonant frequency. The vibratory stresses are measured by means of strain gauges attached to the blade, as shown in Fig. 6; which also shows a typical crack formed as a result of fatigue testing.

Originally, at the request of airline operators, blades were polished and had no surface treatment, and one of the adverse features revealed by the fatigue test programme was the intercrystalline corrosion present to some degree on most of these blades.

This effect was more pronounced with some operators' aircraft than with others; the variations being explained by differences in working and climatic conditions.

Although this corrosion extended in depth nowhere deeper than 0·005 in, it could, if allowed to develop appreciably, affect the fatigue life of a blade. Accordingly, steps were taken to ensure that this corrosion was removed on the earliest occasion possible without interrupting the operators' service requirements, and that protection was subsequently afforded to the blade surfaces either by anodising or by the application of an epoxy resin paint.

The fatigue testing of blades, blade bearings and hubs after operational service commenced with the propellers used on the first turboprop airliner—the Viscount—and is now extended to the Fokker and Fairchild Friendship aircraft. It will shortly be applied also to the latest machines which include the Avro 748, Armstrong Whitworth Argosy, Grumman Gulf-stream, Handley-Page Herald and the Japanese YS11 Freighter.

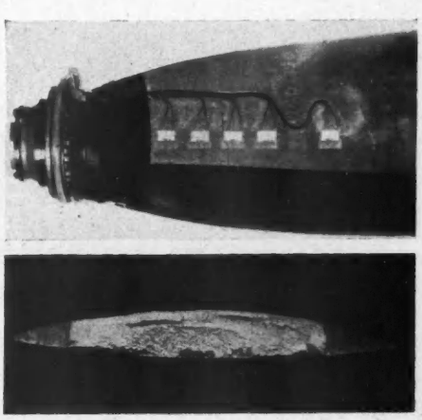


Fig. 6 (above) Propeller blade after prolonged fatigue test, showing crack; (below) section through crack, showing typical fatigue failure.

Furniture with Purpose

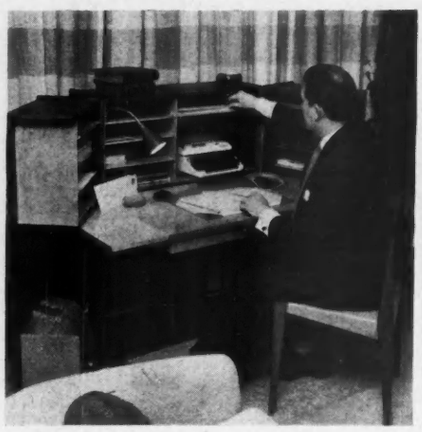
For a great many men an office or study at home is a necessity. Providing it, however, runs into the eternal problem of space: not many houses can afford to put aside a room for the purpose, with the result that papers and typewriter have to spread around the living room and all too easily get lost.

From Norway comes a complete folding office unit, shown in the upper pair of illustrations, distributed in this country by Badenia Calculators Limited, Lion House, Red Lion Street, London, WC1. When not required it makes a neat looking cabinet (as on the left) measuring only 21¼ in deep by 32¼ in wide, but when wanted it opens out into a most comprehensive office (as on the right) with a width of 64½ in. The height is 45½ in.

The two doors have shelves above, and filing space below the writing level; more shelves and space for stowing a typewriter are provided in the back, while from the back a writing table pulls out with a drawer beneath it fitted with an equipment tray. Below that again is a pullout shelf to take maps, plans or large ledgers. Built in at the top left is an adjustable lamp and a telephone on the top can easily be reached from a seated position. The cabinet is constructed in mahogany and birch making it suitable for most room decoration schemes. Apart from the question of more tidiness, the fact that all papers and materials are to hand removes the intense irritation of having to find everything before starting work, and then of having to find somewhere to work anyway, and should also be conducive to better correspondence.

Another perennial problem is solved, or at least avoided, by the item shown in the second pair of illustrations—namely that of stowing the vacuum cleaner. Bylock Electric Limited, of Enfield, Middlesex, have produced the Tablevac, a combined occasional table and vacuum cleaner. It is intended primarily for one floor dwellings, flats, apartments or bungalows, where storage is at a premium and where the question of carrying the cleaner up or down stairs does not normally arise.

As a table (on the left) it is an attractive piece of furniture with a heat resistant polyester top and silent running castors. A rubber guard prevents damage to other furniture. As a cleaner it has powerful suction from a 300 watt TV suppressed motor. The dust is collected in disposable paper bags, which have windows to check the fullness, and these can be placed straight into the dustbin when used. The hose is 1 1/16 in bore, 5 ft 6 in long, and has a screw fitting with swivels at each end. A full set of accessories is included—floor nozzle, extension tubes, dusting brushes, crevice nozzle—all of which have a place within the unit, and the price is no more than many conventional cleaners at present on the market.



(*Above*) *For the man who has to work at home, the Miniature Office provides room for all his needs but is yet small enough for a normal room.*

(*Below*) *The problem of storing a vacuum cleaner is met by the Tablevac combination unit which for most of the time is an occasional table fit to grace any lounge.*

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